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ABSTRACT

Six learning activity packets (LAPs) are provided for the instructional area of electrical systems in the auto mechanics II program. They accompany an instructor's guide available separately. The LAPs outline the study activities and performance tasks for these six units: (1) basic electrical theory, (2) battery service, (3) starting system, (4) ignition system, (5) charging system, and (6) chassis wiring. A cover sheet to each LAP sets forth purpose, an introduction, and list of tasks included. Each LAP contains these components: a checklist of learning steps, pretest (with answers), and assignment sheets (with answers). (YLB)

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LEARNING ACTIVITY PACKETS
for AUTO MECHANICS II

LAP NO. ____________

CODE: ____________

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT I--BASIC ELECTRICAL THEORY

LEARNING ACTIVITY PACKET NO.	**PREREQUISITE LAP(S)**
9	NONE

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Basic Electrical Theory." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify different types of electrical circuits, basic electrical symbols, and testing instruments. Students should be able to describe factors concerning electrical flow, voltage, amperage, ohms, and characteristics of magnetism and electromagnetism.

TASKS INCLUDED IN THIS LAP:

1. Construct a series circuit.
2. Construct a parallel circuit.

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SECTION C--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LEARNING STEPS

Check the following
blanks as you complete
the require steps

_____ 1. Read Unit and Specific Objectives, pages AM II-1-B and 2-B.

_____ 2. Complete Basic Electrical Theory Pretest, LAP page 7.

_____ 3. Study The sections of the Information Sheet, pages AM II-5-B through 12-B, indicated by your instructor on your pretest.

_____ 4. Refer To Step 19 of the pretest. If additional study is required continue to Learning Step 5. Otherwise, proceed to Learning Step 16.

_____ 5. Do LAP Assignment Sheet #1, LAP page 17.

_____ 6. Do LAP Assignment Sheet #2, LAP page 25.

_____ 7. Do Assignment Sheet #1--Calculate Voltage Using Ohm's Law, pages AM II-29-B and 30-B.

_____ 8. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Learning Step 10. Otherwise, continue to Learning Step 9.

LEARNING STEPS

_____ 9. Do LAP Assignment Sheet #3, LAP page 31.

_____ 10. Do Assignment Sheet #2--Calculate Current Flow in Amperes Using Ohm's Law, pages AM II-31-B and 32-B.

_____ 11. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Learning Step 13. Otherwise, continue to Learning Step 12.

_____ 12. Do LAP Assignment Sheet #4, LAP page 33.

_____ 13. Do Assignment Sheet #3--Calculate Resistance Using Ohm's Law, pages AM II-33-B and 34-B.

_____ 14. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Learning Step 16. Otherwise, continue to Learning Step 15.

_____ 15. Do LAP Assignment Sheet #5, LAP page 35.

_____ 16. Check The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Construct a series circuit (19).	__________	__________
_____b.	Construct a parallel circuit (25).	__________	__________

LEARNING STEPS

_____17. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Learning Step 31. Otherwise, continue to Learning Step 18.

_____18. Refer — To Learning Step 16a. If this task has been initialed by your instructor, proceed to Learning Step 24. Otherwise, continue to Learning Step 19.

_____19. Study — Job Sheet #1--Construct a Series Circuit, pages AM II-37-B through AM II-39-B.

_____20. Watch — Slide/tape presentation, "Construct a Series Circuit" (B-I-1).

_____21. Do — Job Sheet #1--Construct a Series Circuit.

_____22. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 16a and proceed to Learning Step 24. Otherwise, repeat Learning Steps 19 through 21 and then continue to Learning Step 23.

_____23. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 17a and continue to Learning Step 24. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 16a and then continue to Learning Step 24.

_____24. Refer — To Learning Step 16b. If this task has been initialed by your instructor, proceed to Learning Step 30. Otherwise, continue to Learning Step 25.

LEARNING STEPS

_____25. Study — Job Sheet #2--Construct a Parallel Circuit, pages AM II-41-B through AM II-43-B.

_____26. Watch — Slide/tape presentation, "Construct a Parallel Circuit" (B-I-2).

_____27. Do — Job Sheet #2--Construct a Parallel Circuit.

_____28. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 17b and proceed to Learning Step 30. Otherwise, repeat Learning Steps 25 through 27 and then continue to Learning Step 29.

_____29. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 17b and continue to Learning Step 30. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 17b and then continue to Learning Step 30.

_____30. Refer — To Learning Step 16. If both tasks have been initialed by your instructor, continue to Learning Step 31. Otherwise, refer to the step indicated in parentheses after the unsigned task.

_____31. Review — Information Sheet (pages AM II-5-B through 12-B) and LAP Assignment Sheets.

_____32. Take — Basic Electrical Theory Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION B--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

PRETEST

NAME ______________________ SCORE ______________

DIRECTIONS: This pretest is to determine how much you already know about basic electrical theory. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

    a. Atom--**Smallest particle into which an element can be divided**

    b. Positively charged atom--**Atom with too few electrons**

    c. Negatively charged atom--**Atom with too many electrons**

    d. Load (consumer)--**Object that converts electricity into heat, light, or mechanical energy**

    e. Electron--**Negatively charged particle; circles nucleus of atom**

    f. Proton--**Positively charged particle in the nucleus of an atom**

    g. Conductor--**Any material which allows electrical current to flow easily**

    h. Circuit--**Continuous conductor path from electrical source to load and then back to the source**

    i. Insulator--**Material that resists the flow of electrical current**

j. Electromotive force--**Tends to cause a flow of electricity; measured in volts**

k. Polarity--**Term that applies to ends of a magnet or the direction of current flow through a circuit**

l. Direct current--**Steady flow of electrons in one direction through a circuit**

m. Alternating current--**Electron flow that reverses direction at intervals**

n. Magnet--**Material with the ability to attract iron or other magnets**

o. Ion--**Atom or group of atoms with a positive or negative charge resulting from loss or gain of electrons**

p. Current--**Flow of electrons measured in amperes**

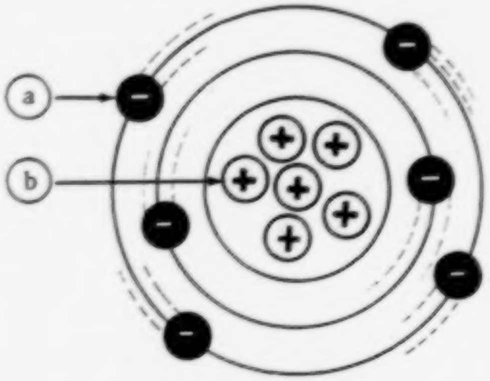
q. Magnetic field--**Area surrounding a magnet in which the magnetic attraction can be detected**

r. Flux lines--**Magnetic lines of force existing in the magnetic field**

2. Identify the parts of the atom shown in the drawing below. Write the correct names of the parts in the corresponding blanks.

a. **Electron**

b. **Proton**



PRETEST

3. Fill in the missing words in the statements below.

   a. Electrons flow from **negative** to **positive** through a conductor.

   b. **Voltage** is the term used to describe the force which causes elections to flow.

   c. A complete **circuit** is required to allow electrons to flow.

4. List the three basic factors of electrical flow in a circuit.

   a. **Voltage (volts)**

   b. **Current (amperes)**

   c. **Resistance (OHMS)**

5. Describe the relationship current flow to voltage, amperage, and ohms.

   a. Voltage--**Difference in electrical pressure between two points in a circuit**

   b. Amperage--**Rate of electron flow**

   c. Ohms--**Resistance to current flow**

6. State Ohm's Law.

   One volt of electricity is required to push one ampere of current through one ohm of resistance.

7. Calculate the following problems using Ohm's Law.

   I = Amperage (current)
   E = Voltage (volts)
   R = Ohms (resistance)

   a. If, I = 8 amps and
      R = 2 ohms then
      E = **16 volts**

   b. If, R = 4 ohms, and
      E = 16 volts then
      I = **4 amps**

   c. If, E = 50 volts, and
      I = 10 amps then
      R = **5 ohms**

PRETEST

8. List four factors that affect resistance in a conductor.

a. **Length**

b. **Type of material**

c. **Temperature**

d. **Cross-section (size of conductor)**

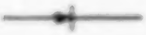
9. Identify the following basic electrical symbols. Write the meanings of the symbols in the blanks.

+

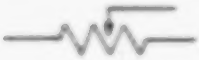
a. **Positive terminal**

−

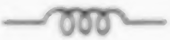
b. **Negative terminal**



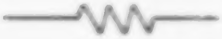
c. **Diode (one-way)**



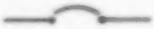
d. **Variable resistor**



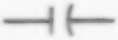
e. **Coil**



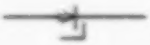
f. **Fixed resistor**



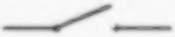
g. **Circuit breaker**



h. **Condenser (Capacitor)**



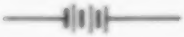
i. **Zener diode**



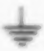
j. **Switch, open**

Ω

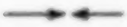
k. **Ohm**



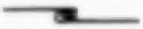
l. **Battery**



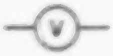
m. **Ground**



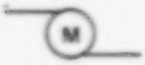
n. **Spark Gap**



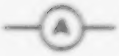
o. **Contact points**



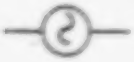
p. **Voltmeter**



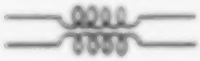
q. **Motor (D.C.)**



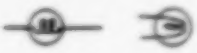
r. **Ammeter**



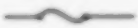
s. **Alternator**



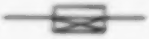
t. **Induction coil**



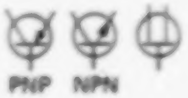
u. **Lamp**



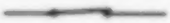
v. **Fuse**



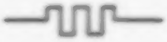
w. **Fusible link or wire**



x. **Transistor**



y. **Switch, closed**



z. **Thermal element**

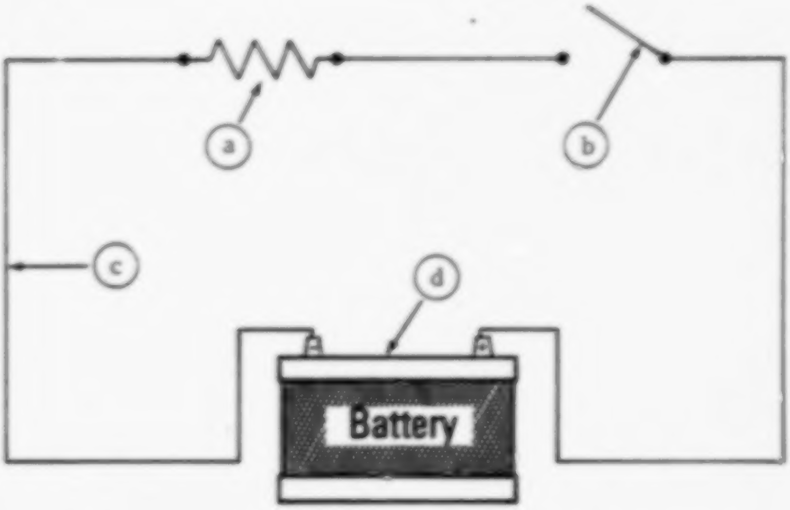
10. Identify the parts of the basic circuit shown below. Write the correct names of the parts in the corresponding blanks.

a. **Load**

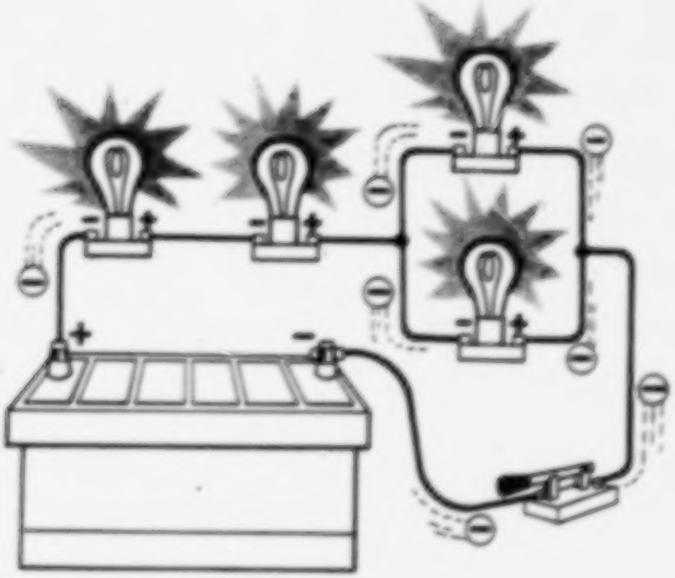
c. **Conductor**

b. **Switch**

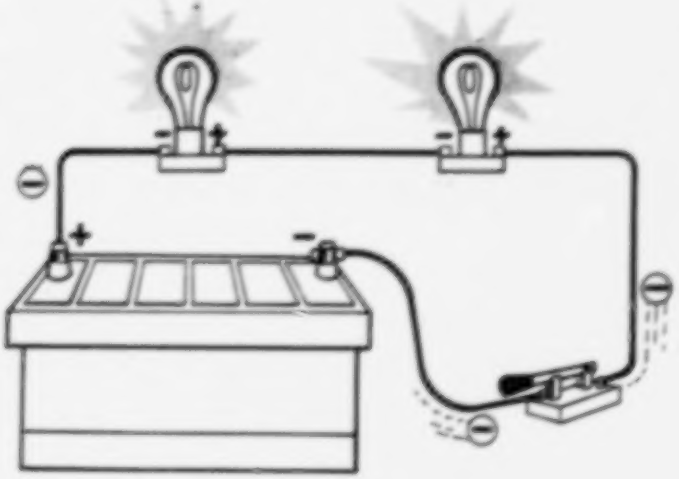
d. **Source**



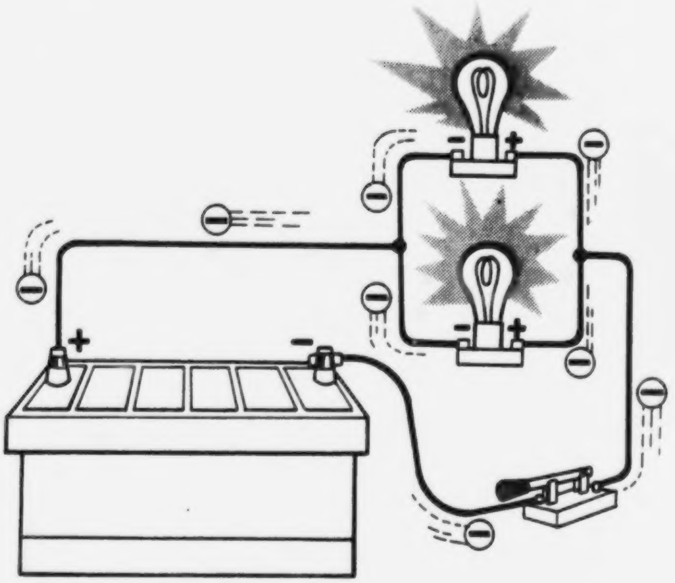
11. Identify the following electrical circuits. Write their correct names in the blanks below the drawings.



a. **Series-parallel**

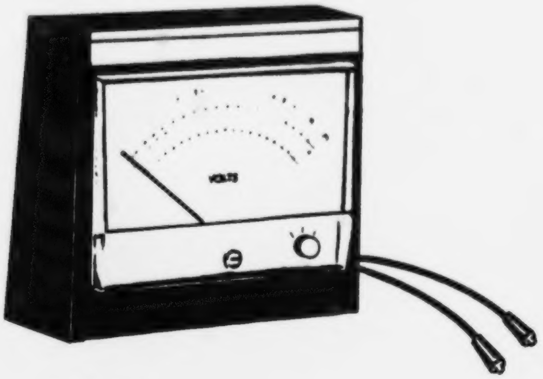


b. **Series**

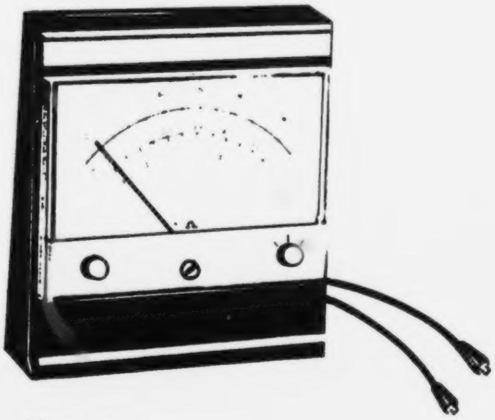


c. **Parallel**

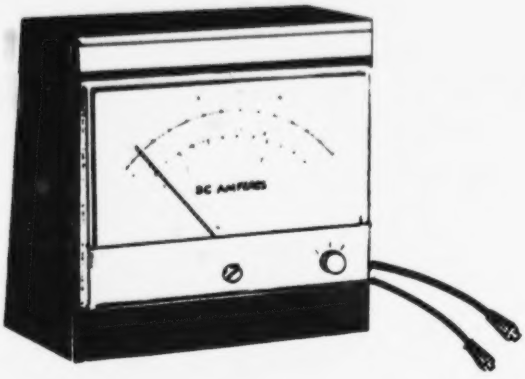
12. Identify the following electrical circuit testing instruments. Write their correct names in the blanks.



a. **Voltmeter**



b. **Ohmmeter**



c. **Ammeter**

13. Describe methods for connecting test instruments to a circuit.

    a. Ammeter--**Connect in series with circuit while current is flowing**

    b. Voltmeter--**Connect in parallel with the circuit**

    c. Ohmmeter--**Connect in series with circuit; make sure circuit is disconnected from current source**

14. Define the following electrical circuit failures.

    a. Short circuit--**Unwanted connection that bypasses all or part of the circuit**

    b. High resistance circuit--**Caused by faulty or corroded connections or by damaged wires**

    c. Grounded circuit--**Unwanted connection between the insulated side and the grounded side of the circuit**

    d. Open circuit--**Break in circuit causing extremely high resistance**

PRETEST

15. Circle the correct word in each of the following statements.

a. Lines of magnetic force move from north to south on the (inside/[✓ outside]) of the magnet.

b. Lines of magnetic force move from south to north on the ([✓ inside]/outside) of a magnet.

c. (Like/[✓ Unlike]) poles attract each other.

d. ([✓ Like]/Unlike) poles repel each other.

e. Magnetic lines of force tend to ([✓ parallel]/intersect) each other.

16. List four characteristics of electromagnetism.

a. **Iron core increases strength of magnet**

b. **An energized electromagnet has the same properties as a permanent magnet**

c. **Magnetic field is established around energized conductor**

d. **Electromagnetic strength increases as amount of current or number of coils is increased**

17. Describe electromagnetic induction.

Voltage is induced by expanding and contracting lines of magnetic force crossing a conductor. Either the conductor or the line of force may move. Induction occurs when a changing current in one coil induces a voltage in an adjacent coil.

18. List three factors which determine the magnitude of induced voltage.

a. **Strength of magnetic field**

b. **Speed at which lines of force cross conductor**

c. **Number of conductors cutting across lines of force**

PRETEST

19. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I
_____II
_____III
_____IV
_____V
_____VI
_____VII
_____VIII
_____IX
_____X
_____XI
_____XII
_____XIII
_____XIV
_____XV
_____XVI
_____XVII
_____XVIII

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 16. Otherwise, continue to Learning Step 3.

SECTION A--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LAP ASSIGNMENT SHEET #1

NAME ______________________ SCORE ______________

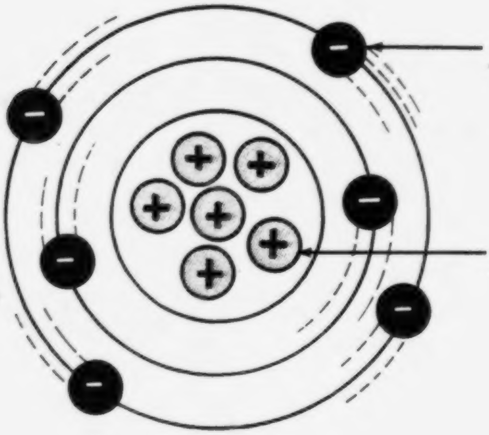
1. Match the terms and definitions listed below. Write the correct numbers in the blanks.

4 a. Negatively charged particle
5 b. Atom with too few electrons
6 c. Atom with too many electrons
9 d. Converts electricity into light, heat, or mechanical energy
11 e. Continuous conductor path
7 f. Smallest particle
12 g. Steady electron flow in one direction
18 h. Measured in volts; causes flow of electricity
3 i. Positively charged particle; part of atom nucleus
10 j. Electron flow measured in amperes
13 k. Electron flow that reverses direction at intervals
14 l. Term that applies to magnetic poles and direction of current flow
15 m. Material with the ability to attract iron
2 n. Area surrounding a magnet
17 o. Material that allows current to flow easily
8 p. Material that resists electrical current flow
1 q. Magnetic lines of force in the magnetic field
16 r. Atom or molecule with positive or negative charge due to loss or gain of electrons

1. Flux lines
2. Magnetic field
3. Proton
4. Electron
5. Positively charged atom
6. Negatively charged atom
7. Atom
8. Insulator
9. Load
10. Current
11. Circuit
12. Direct current
13. Alternating current
14. Polarity
15. Magnet
16. Ion
17. Conductor
18. Electromotive force

LAP ASSIGNMENT SHEET #1

2. Identify the parts of the atom shown below. Write the correct names of the parts in the blanks.



Electron

Proton

3. Fill in the missing words in the statements below.

   a. Electrons flow from **negative** to **positive**.

   b. **Voltage** is needed to cause electrons to move.

   c. A complete **circuit** is necessary for electron flow.

4. Match the following terms and definitions. Write the correct numbers in the blanks.

   2 a. Rate of electron flow

   1 b. Difference in electrical pressure between two points in a circuit

   3 c. Resistance to current flow

   1. Voltage
   2. Amperage
   3. Ohm

5. Fill in the missing words in the statement below.

   Ohm's Law states that one **volt** is required to pass one **ampere** through one **ohm** of resistance.

LAP ASSIGNMENT SHEET #1

6. List the four factors that affect conductor resistance.

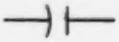
   a. **Material**

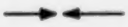
   b. **Size of conductor (cross-section)**

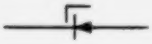
   c. **Length of conductor**

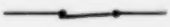
   d. **Temperature**

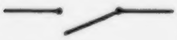
7. Identify the electrical symbols shown below. Write the correct names in the blanks beside the symbols.

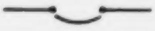
a.  **Condenser**

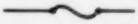
b.  **Spark gap**

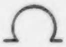
c.  **Zener diode**

d.  **Switch**

e.  **Switch (open)**

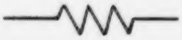
f.  **Circuit breaker**

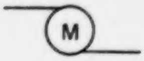
g.  **Fuse**

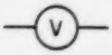
h.  **Ohm**

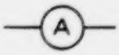
i. **Positive**

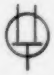
j. **Negative terminal**

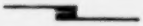
k.  **Resistor (fixed)**

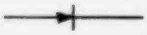
l.  **Motor (D.C.)**

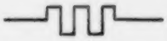
m.  **Voltmeter**

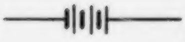
n.  **Ammeter**

o.  **Transistor**

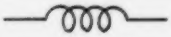
p.  **Contact points**

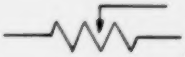
q.  **Diode (one-way)**

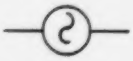
r.  **Thermal element**

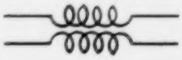
s.  **Battery**

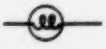
t. **Ground**

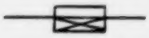
u.  **Coil**

v.  **Variable resistor**

w.  **Alternator**

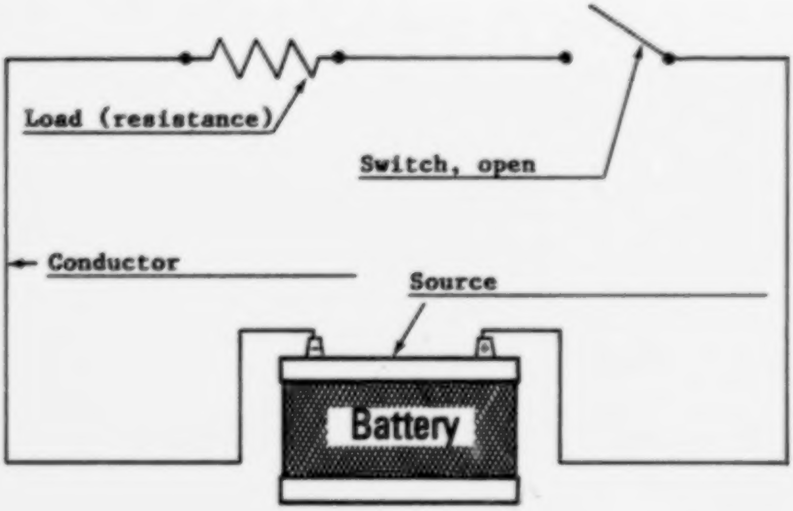
x.  **Induction coil**

y.  **Lamp**

z.  **Fusible link or wire**

LAP ASSIGNMENT SHEET #1

8. Identify the parts of the circuit shown below. Write the correct names of the parts in the blanks.

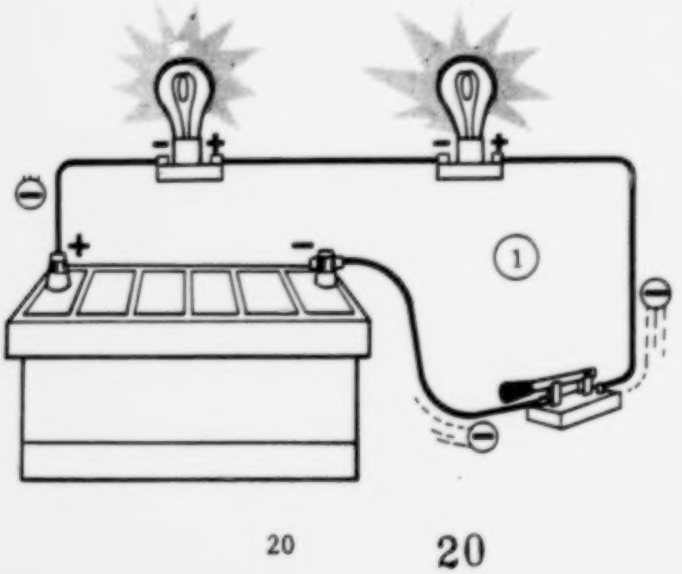


9. Match the following illustrations of circuits and their names. Write the correct numbers in the blanks.

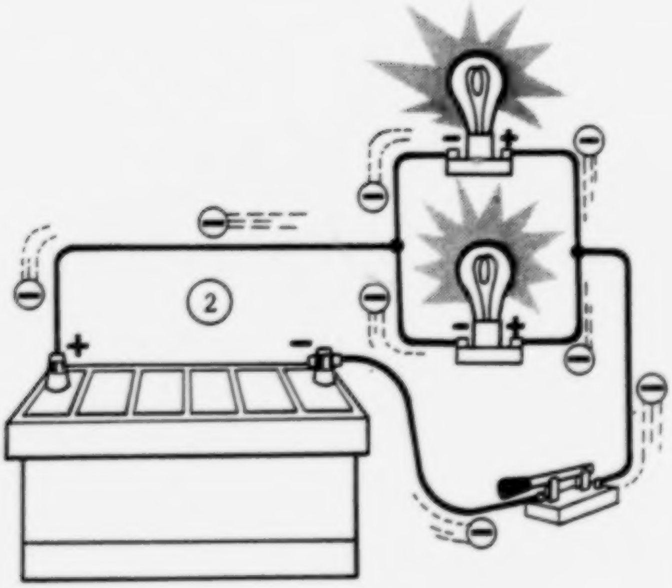
1 Series

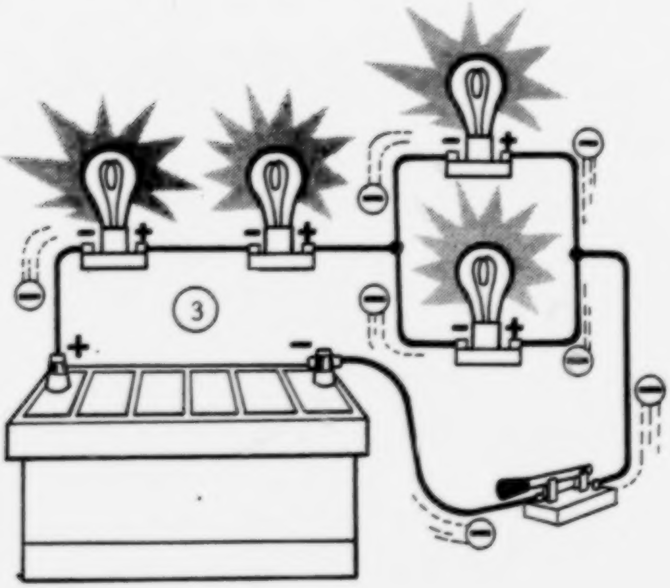
2 Parallel

3 Series-parallel



LAP ASSIGNMENT SHEET #1





LAP ASSIGNMENT SHEET #1

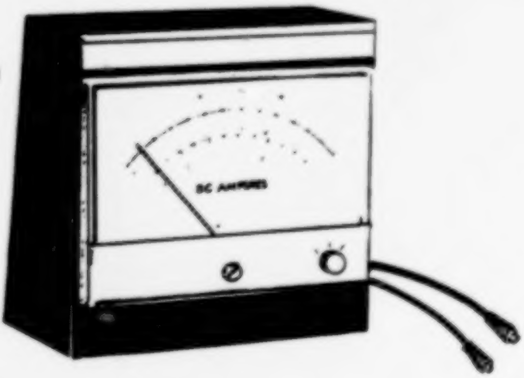
10. Match the names and illustrations of the instruments shown below. Write the correct numbers in the blanks.

__1__ Ammeter

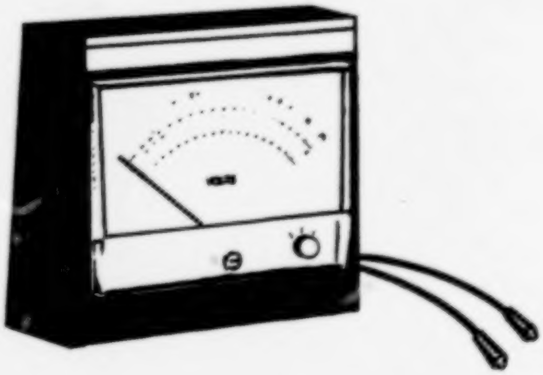
__3__ Ohmmeter

__2__ Voltmeter

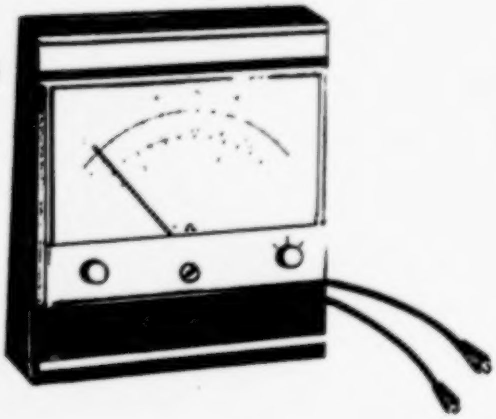
①



②



③



11. Describe the proper method of connecting each of the test instruments in the previous question.

a. Ohmmeter--**Connect in series; disconnect circuit from power source**

b. Voltmeter--**Connect in parallel while circuit is energized**

c. Ammeter--**Connect in series on energized circuit**

LAP ASSIGNMENT SHEET #1

12. List the four basic causes of electrical circuit failure.

a. **Open circuit**

b. **Short circuit**

c. **Grounded circuit**

d. **High resistance circuit**

13. Below are listed characteristics of magnetism and electromagnetism. Some characteristics only apply to natural magnetism, others only apply to electromagnetism and a third group apply to both natural magnetism and electromagnetism. In the blank next to each characteristic put "NM" if the characteristic only applies to natural magnetism, "EM" if it applies to electromagnetism, and "BOTH" if the characteristics applies to natural and electromagnetism.

BOTH a. Has a north and south pole

NM b. Is a permanent magnet

EM c. Can vary in strength of magnetic field

BOTH d. Like poles repel each other

EM e. Is a temporary magnet

BOTH f. Lines of force run parallel

EM g. Iron core increases strength of magnetism

14. Explain why electromagnetic induction of electricity occurs only when one or both of two things happens.

Magnetic lines of force must cut across a conductor, a conductor must move through magnetic lines of force, or both may happen at the same time

15. List three factors which determine the magnitude of an induced voltage.

a. **Strength of magnetic field**

b. **Speed at which lines of force cut across conductor**

c. **Number of conductors cutting across lines of force**

LAP ASSIGNMENT SHEET #1

16. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____I
____II
____III
____IV
____V
____VI
____VII
____VIII
____IX
____X
____XI
____XII
____XIII
____XIV
____XV
____XVI
____XVII
____XVIII

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 6.

SECTION A--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LAP ASSIGNMENT SHEET #2

NAME ______________________________ SCORE ____________________

1. Below are listed the definitions for the terms used in basic electrical theory. Write the correct term for each definition in the blank.

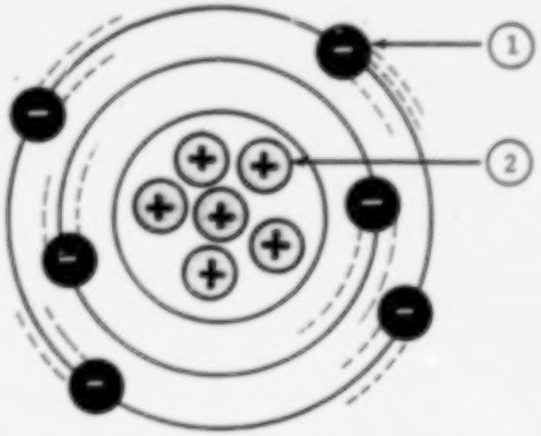
   a. **Electron**--Negatively charged particle.
   b. **Negatively charged atom**--Atom with too many electrons.
   c. **Polarity**--Refers to direction of current flow in a circuit.
   d. **Ion**--Positively or negatively charged atom or molecule.
   e. **Magnetic field**--Area surrounding a magnet.
   f. **Insulator**--Resists current flow.
   g. **Flux lines**--Magnetic lines of force.
   h. **Load**--Converts electricity into heat, light, or mechanical energy.
   i. **Direct current**--Electrons all flowing in one direction.
   j. **Alternating current**--Direction of electron flow reversed at intervals.
   k. **Electromotive force**--Measured in volts.
   l. **Current**--Measured in amperes.
   m. **Proton**--Positively charged particle; part of nucleus.
   n. **Magnet**--Material with the ability to attract iron.
   o. **Atom**--Smallest particle into which an element may be divided.
   p. **Circuit**--Continuous conductor path.
   q. **Conductor**--Allows electrical current to flow easily.
   r. **Positively charged atom**--Atom with too few electrons.

LAP ASSIGNMENT SHEET #2

2. Match the terms and the labeled parts of the atom shown below. Write the correct numbers in the blanks.

1 Electron

2 Proton



3. Fill in the missing words in the statements below.

a. Electrons flow from negative to positive.

b. EMF stands for electromotive force.

c. EMF is measured in volts.

d. A complete circuit must have a path from the source to the load and back to the source.

e. Ohm's Law states that one volt is required to pass one ampere of current through a one ohm resistance.

4. Define the terms below.

a. Voltage--Difference in electrical pressure between two points

b. Amperage--Rate of electron flow

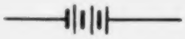
c. Resistance--Resistance to electrical flow

5. Fill in the missing word in this statement:

The type of material, temperature, length, and size of a conductor all affect the electrical resistance in the conductor.

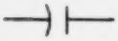
LAP ASSIGNMENT SHEET #2

6. Draw the electrical symbol for each of the following.

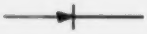
a. Battery 

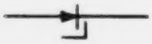
b. Positive +

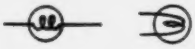
c. Negative −

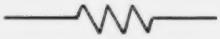
d. Capacitor 

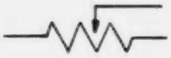
e. Ground

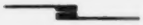
f. Diode 

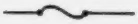
g. Zener diode 

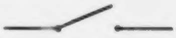
h. Bulb 

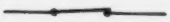
i. Resistor 

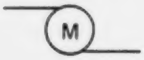
j. Variable resistor 

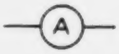
k. Contact points 

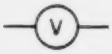
l. Fuse 

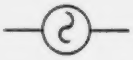
m. Open switch 

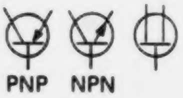
n. Closed switch 

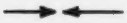
o. Motor (D.C.) 

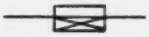
p. Ammeter 

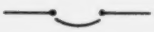
q. Voltmeter 

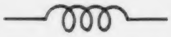
r. Alternator 

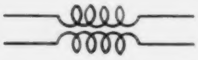
s. Transistor 

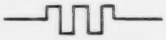
t. Spark gap 

u. Fusible line 

v. Circuit breaker 

w. Coil 

x. Induction coil 

y. Thermal element 

z. Ohm Ω

LAP ASSIGNMENT SHEET #2

7. List the four parts of a basic circuit.

   a. **Load**

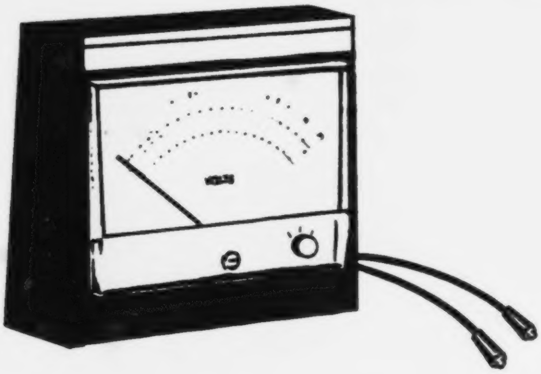
   b. **Switch**

   c. **Source**

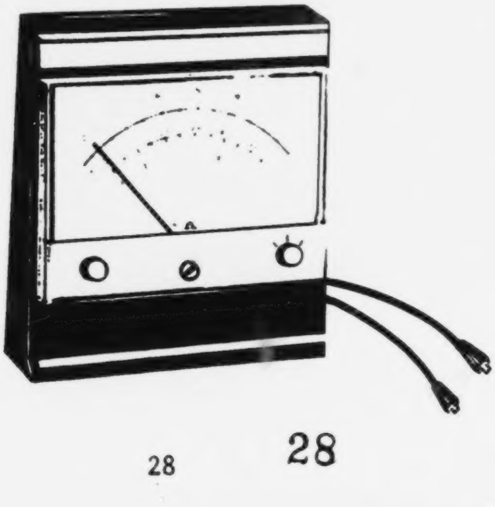
   d. **Conductor**

8. Identify the three test instruments shown below, and describe the proper method of connecting each instrument when testing a circuit. Write their names and descriptions in the blanks above the drawings.

   a. **Voltmeter--Connect in parallel on energized circuit**

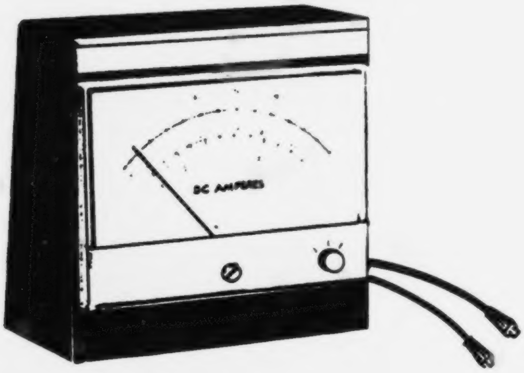


   b. **Ohmmeter--Attach in series; circuit MUST be disconnected from power source**



LAP ASSIGNMENT SHEET #2

c. **Ammeter--Connect in series on energized circuit**



9. List the three types of basic electrical circuits.

   a. **Series**

   b. **Parallel**

   c. **Series-parallel**

10. Define the following electrical circuit failures.

    a. Open circuit--**Break in electrical circuit resulting in very high resistance**

    b. Short circuit--**Unwanted electrical connection that bypasses all or part of the circuit**

    c. Grounded circuit--**Connection which bypasses all or part of the circuit from the insulated side to the grounded side of the circuit**

    d. High resistance circuit--**Caused by poor or corroded connections or damaged wires**

11. Write "True" or "False" in the blanks before the following statements about magnetism and electromagnetism.

    True a. All magnets have north and south poles

    False b. Magnetic lines of force exist only around electromagnets

LAP ASSIGNMENT SHEET #2

True c. An electromagnet's strength increases as current is increased

True d. Magnetic lines of force tend to parallel each other

False e. Like poles attract and unlike poles repel each other

True f. Magnetic lines of force move north to south on the outside and south to north on the inside of a magnet

True g. An air-core electromagnet is not as strong as an iron-core electromagnet with the same amount of current and number of coils

True h. Increasing the number of coils in an electromagnet has the same effect on its strength as increasing the current

12. Fill in the missing words in the statements below.

    a. Electric induction occurs when a changing **current** in one coil induces a **voltage** in an second adjacent **coil**.

    b. Three factors which determine the size of an induced voltage include the **strength** of the magnetic field, the **speed** at which the lines of force cut across the **conductor**, and the number of **conductors** cutting across the lines of force.

13. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

SECTION A--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LAP ASSIGNMENT SHEET #3

NAME ______________________________ SCORE ____________________

Calculate voltage using Ohm's Law

$$E = I \times R$$

1.

	AMPERES	OHMS	VOLTS
a.	5.0	100	**500**
b.	4.0	20	**80**
c.	10.0	40	**400**
d.	25.0	75	**1875**
e.	0.5	10	**5**

2. If the starter motor on the vehicle has a 0.05 ohm resistance and requires 200 amps of current, what voltage will be required?

   10 volts

3. If an ammeter reads 1.2 amps across a 50 ohm resistor, what is the circuit voltage?

   60 volts

4. The cassette player you just installed in your car has an internal resistance of 100 ohms and requires 0.05 amps of current. How much voltage is needed?

   5 volts

5. A 15 amp fan has an internal resistance of 0.5 ohms. How much voltage will be required to operate the fan?

   7.5 volts

6. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 10. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 10.

SECTION A--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LAP ASSIGNMENT SHEET #4

NAME ______________________________ SCORE ____________________

1. Calculate current flow using Ohm's Law.

$$I = \frac{E}{R}$$

	VOLTS	OHMS	AMPERES
a.	0.5	75.0	**0.007**
b.	12.0	60.0	**0.2**
c.	60.0	360.0	**0.17**
d.	120.0	0.75	**160**
e.	75.0	1.5	**50**

2. A starter motor has 0.12 ohms. How much current must a 6-volt battery supply?

50 amps

3. A television has an internal resistance of 375 ohms. How much current will it draw from a 110-volt line?

29.3 amps

4. A fog light has 90 ohms of internal resistance. How much current will it draw from a 12-volt battery?

0.13 amps

5. The air conditioner fan has a 20-ohm internal resistance. How much current will it draw from a 12-volt system?

.6 amps

How much current will it draw from a 6-volt system? **0.3 amps**

6. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 13. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 13.

SECTION B--ELECTRICAL SYSTEMS
UNIT I--BASIC ELECTRICAL THEORY

LAP ASSIGNMENT SHEET #5

NAME ______________________ SCORE ______________

1. Calculate resistance using Ohm's Law.

$$R = \frac{E}{I}$$

	VOLTS	AMPERES	OHMS
a.	12.0	2.5	4.8
b.	6.0	4.0	1.5
c.	9.6	2.9	3.3
d.	10.0	0.25	40
e.	115.0	160.0	0.72

2. What is the resistance of a light bulb drawing 2 amps on a 6-volt line?

3 ohms

3. A horn draws 5.9 amps on 12 volts. What is the internal resistance of the horn?

2.03 ohms

4. If the 110-volt electrical drill draws 55 amps, what is the drill's internal resistance?

2 ohms

5. What is the internal resistance of an ignition coil that draws 2.5 amps on a 12-volt system?

4.8 ohms

6. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 16. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 16.

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LEARNING ACTIVITY
PACKETS

for AUTO MECHANICS II

LAP NO. ____ CODE: ____

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT II--BATTERY SERVICE

LEARNING ACTIVITY PACKET NO. 10

PREREQUISITE LAP(S) 9

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Battery Service." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this speciality.

INTRODUCTION: The course of study in the LAP will help the student become able to list the functions of a battery and battery safety rules and describe battery ratings and the process of converting chemical energy into electrical energy. The student will also be able to service and load test a battery.

TASKS INCLUDED IN THIS LAP:

1. Clean and service a battery.
2. Remove and replace a battery.
3. Measure battery electrolyte with a hydrometer.
4. Load test a battery.
5. Charge test a battery for three minutes.

SECTION B--ELECTRICAL SYSTEMS
UNIT II--BATTERY SERVICE

LEARNING STEPS

Check the following
blanks as you complete
the required steps

_____ 1. Read Unit and Specific Objectives, page AM II-57-B.

_____ 2. Complete Battery Service Pretest, LAP page 9.

_____ 3. Study The sections of the Information Sheet, pages AM II-61-B through 64-B, indicated by your instructor on Step 10 of your pretest. Be sure to study the transparency masters when required.

_____ 4. Refer To Step 10 of your pretest. If additional study is required for any sections of the Information Sheet, Sections I through VIII, then continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do LAP Assignment Sheet #1, LAP page 15.

_____ 6. Do LAP Assignment Sheet #2, LAP page 21.

_____ 7. Check The following tasks that you feel you can perform without supervision.

		Instructor Initials/Date	
Student Check		Skilled	Moderately Skilled
_____	a. Clean and service a battery. (10)	__________	__________

LEARNING STEPS

Student Check			Instructor Initials/Date Skilled	Moderately Skilled
_____	b.	Remove and replace a battery. (16)	___________	___________
_____	c.	Measure battery electrolyte with a hydrometer. (22)	___________	___________
_____	d.	Load test a battery. (28)	___________	___________
_____	e.	Charge test a battery for thr[illegible] minutes. (34)	___________	___________

_____	8.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed by your instructor, then proceed to Learning Step 39. Otherwise, continue to Learning Step 10.
_____	9.	Refer	To Learning Step 7a. If this task has been initialed by your instructor, proceed to Learning Step 15. Otherwise, continue to Learning Step 10.
_____	10.	Study	Job Sheet #1--Clean and Service a Battery, pages AM II-75-B through 78-B.
_____	11.	Watch	Slide/tape presentation, "Remove, Service, and Replace a Battery" (B-II-1&2).
_____	12.	Do	Job Sheet #1--Clean and Service a Battery.
_____	13.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have you instructor initial Learning Step 7a and proceed to Learning Step 15. Otherwise, repeat Learning Steps 10 through 12 and then continue to Learning Step 14.

LEARNING STEPS

_____14. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 15.

_____15. Refer To Learning Step 7b. If this task has been initialed by your instructor proceed to Learning Step 21. Otherwise, continue to Learning Step 16.

_____16. Study Job Sheet #2--Remove and Replace a Battery, pages AM II-79-B through AM II-81-B.

_____17. Watch Slide/tape presentation, "Remove, Service, and Replace a Battery" (B-II-1&2).

_____18. Do Job Sheet #2--Remove and Replace a Battery.

_____19. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and then continue to Learning Step 20.

_____20. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating have your instructor initial Learning Step 7b and continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and then continue to Learning Step 21.

_____21. Refer To Learning Step 7c. If this task has been initialed by your instructor, proceed to Learning Step 27. Otherwise, continue to Learning Step 22.

LEARNING STEPS

_____22. Study — Job Sheet #3--Measure Battery Electrolyte with a Hydrometer, pages AM II-83-B and 84-B.

_____23. Watch — Slide/tape presentation, "Measure Battery Electrolyte with a Hydrometer (B-II-3).

_____24. Do — Job Sheet #3--Measure Battery Electrolyte with a Hydrometer.

_____25. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and then continue to Learning Step 26.

_____26. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction have your instructor initial Learning Step 7c and then continue to Learning Step 27.

_____27. Refer — To Learning Step 7d. If this task has been initialed by your instructor, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.

_____28. Study — Job Sheet #4--Load Test a Battery, page AM II-85-B.

_____29. Watch — Slide/tape presentation, "Load Test a Battery" (B-II-4).

_____30. Do — Job Sheet #4--Load Test a Battery.

LEARNING STEPS

_____31. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d. Otherwise, repeat Learning Steps 28 through 30 and then continue to Learning Step 32.

_____32. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. After you complete that program to your instructor's satisfaction, have your instructor initial Learning Step 7d and then continue to Learning Step 33.

_____33. Refer To Learning Step 7e. If this task has been initialed by your instructor, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.

_____34. Study Job Sheet #5--Charge Test a Battery for Three Minutes, page AM II-87-B.

_____35. Do Job Sheet #5--Charge Test a Battery for Three Minutes.

_____36. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and continue to Learning Step 38. Otherwise, repeat Learning Steps 34 and 35 and then continue to Learning Step 37.

_____37. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and continue to Learning Step 38. If additional study is required, discuss a study program with your instructor. After you complete that program to your instructor's satisfaction, have your instructor initial Learning Step 7e and continue to Learning Step 38.

LEARNING STEPS

_____38. Refer — To Learning Step 7. If all tasks have been initialed by your instructor, continue to Learning Step 39. Otherwise, refer to the learning step indicated in parentheses after the unsigned task.

_____39. Review — Information Sheet (pages AM II-61-B through 64-B) and LAP Assignment Sheets.

_____40. Take — Battery Service Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION B--ELECTRICAL SYSTEMS
UNIT II--BATTERY SERVICE

PRETEST

NAME ______________________ SCORE ______________

DIRECTIONS: This pretest is to determine how much you already know about battery service. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. Electrolyte--**Solution of approximately 60 percent water and 40 percent sulfuric acid**

   b. Hydrometer--**Instrument containing a calibrated float; used to measure specific gravity**

   c. Specific gravity--**Weight of a liquid compared to an equal volume of distilled water**

   d. Dissimilar metals--**Metals unlike in substance or behavior**

   e. Battery--**Connected cells that convert chemical energy into electrical energy**

   f. Plate group--**Similar plates welded to a plate strap**

   g. Sulfated--**Oxidation of positive plate grid wires**

   h. Cell--**One positive and one negative plate group**

   i. Battery rating--**Amount of electricity that can be taken from a fully charged battery over a period of time**

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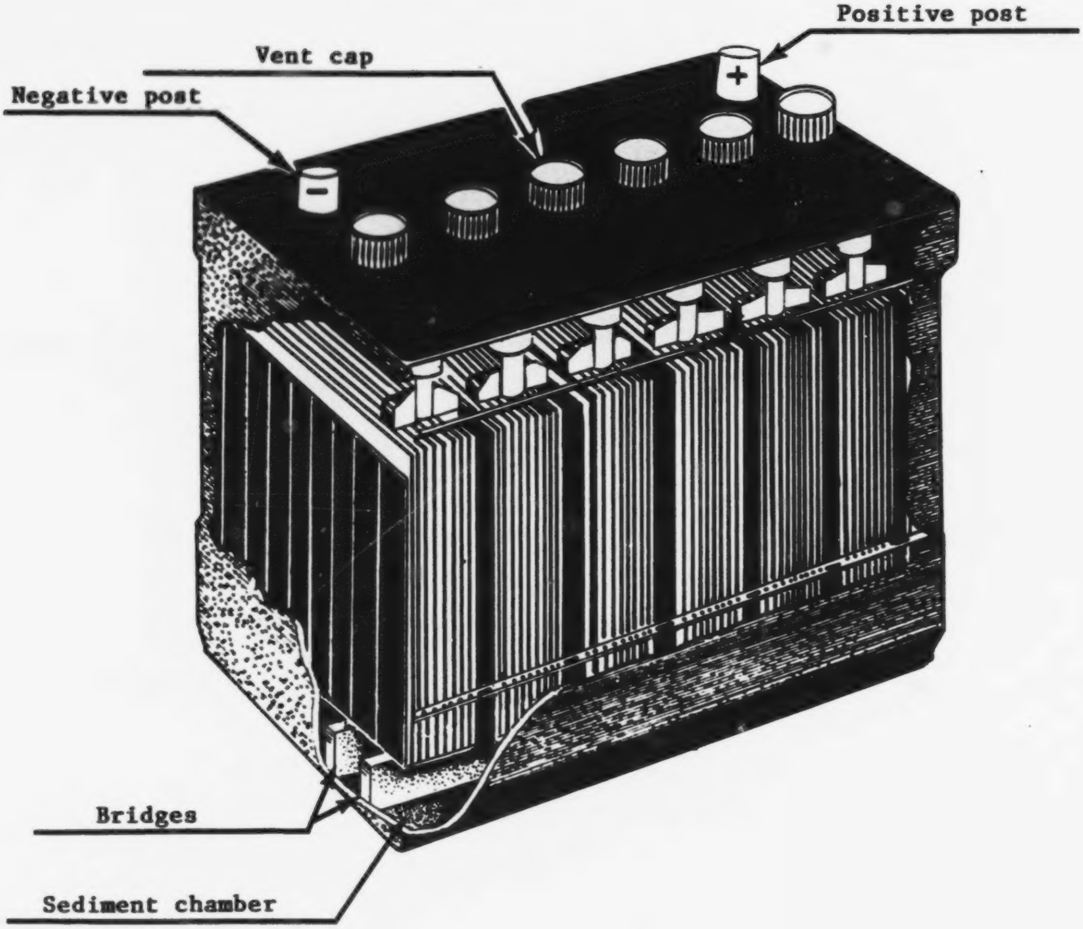
2. List the three functions of the battery.

   a. **To supply electrical power to start the engine**

   b. **To supply current when demand exceeds output of charging system**

   c. **To stabilize voltage in the system during operation**

3. Identify the parts of the battery shown below. Write the correct names of the parts in the blanks.



PRETEST

4. Identify the parts of the battery cell shown below. Write the names of the parts in the correct blanks.

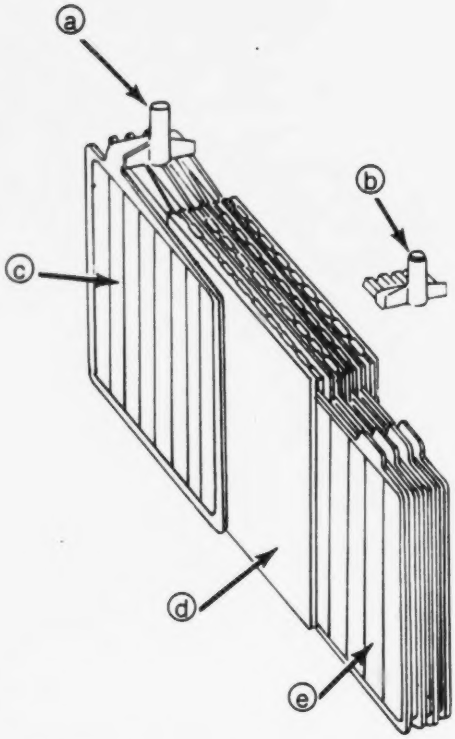
   a. **Terminal post**

   b. **Plate strap casting**

   c. **Negative plate group**

   d. **Separator**

   e. **Positive plate group**



5. Describe the function of each battery part listed below.

   a. Terminal post--**Provides a low resistance battery cable connection**

   b. Battery case--**Holds the cells and electrolyte to make up the completed battery**

   c. Plate--**Stores active material which brings about a chemical reaction to provide electrical energy**

   d. Separator--**Insulates negative plate from positive plate**

e. Cell connector--**Connects cells in series**

f. Vent cap--**Closes opening to each cell; allows gases to escape**

g. Post plate strap--**Connects plate group to terminal post**

6. Describe the battery's process of converting chemical energy into electrical energy.

Two dissimilar metals are placed in on acid solution, beginning a chemical reaction. The more active metal loses electrons and becomes positively charged and the less active metal accumulates electrons and becomes negatively charged.

7. List four factors that affect battery voltage and capacity.

    a. **Number of cells that are connected in series can change battery voltage**

    b. **Number of plates in each cell affect capacity**

    c. **Area of plate material affects capacity**

    d. **Strength of the electrolyte solution affects capacity**

8. Define the following terms.

    a. Ampere-hour rating (reserve capacity rating)--**Length of time in minutes that a fully charged battery at 80° F can deliver a specific amount of current**

    b. Cold cranking rating--**Number of amperes that a battery can deliver for 30 seconds at 0° F without cell voltage dropping below 1.2 volts**

    c. Peak watt rating (PWR)--**Measure of battery's cold cranking ability determined by multiplying maximum current by maximum battery voltage**

9. List three advantages of a service-free battery.

   a. **Sealed case with a lifetime supply of electrolyte**

   b. **Liquid-gas separator that returns liquid to reservoir**

   c. **Special plate material that reduces water loss, self-discharge, and overcharge**

10. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____ I	_____ V
_____ II	_____ VI
_____ III	_____ VII
_____ IV	_____ VIII

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION B--ELECTRICAL SYSTEMS
UNIT II--BATTERY SERVICE

LAP ASSIGNMENT SHEET #1

NAME ______________________ SCORE ______________

1. Identify the correct term for each of the following definitions. Write the correct terms in the blanks.

a. **Sulfated**--Oxidation of positive plate grid wires

b. **Specific gravity**--Weight of a liquid compared to an equal volume of distilled water

c. **Hydrometer**--Instrument used to measure specific gravity

d. **Battery**--Convert chemical energy into electrical energy

e. **Battery rating**--Amount of electricity that can be taken from a fully charged battery

f. **Dissimilar metals**--Metals that are unlike in substance or behavior

g. **Electrolyte**--Solution of 60 percent water and 40 percent sulfuric acid

h. **Plate group**--Similar plates welded to a plate strap

i. **Cell**--One positive plate group and one negative plate group

2. List the three functions of a battery.

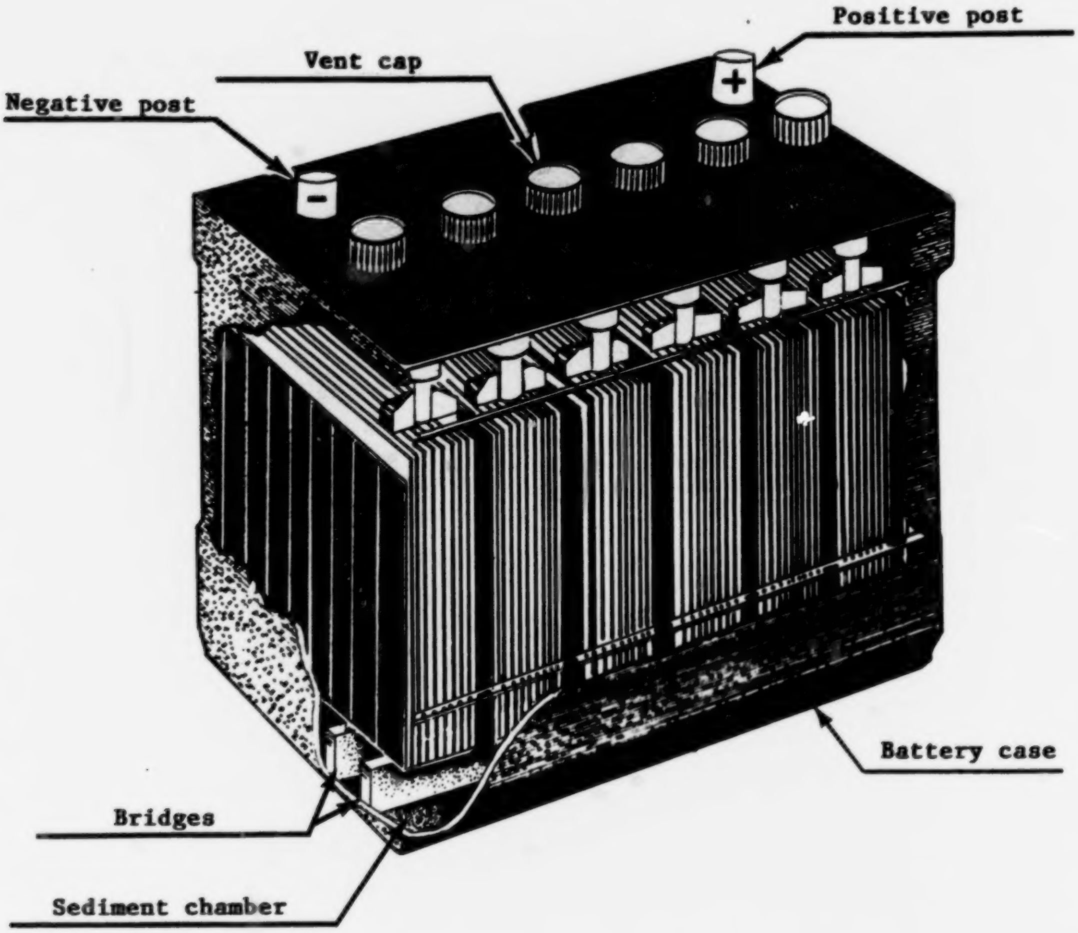
a. **Supplies current to crank engine**

b. **Supplies current when demand exceeds charging system output**

c. **Stabilizes voltage in system during operation**

LAP ASSIGNMENT SHEET #1

3. Identify the parts of the battery shown below. Write the correct names of the parts in the blanks.



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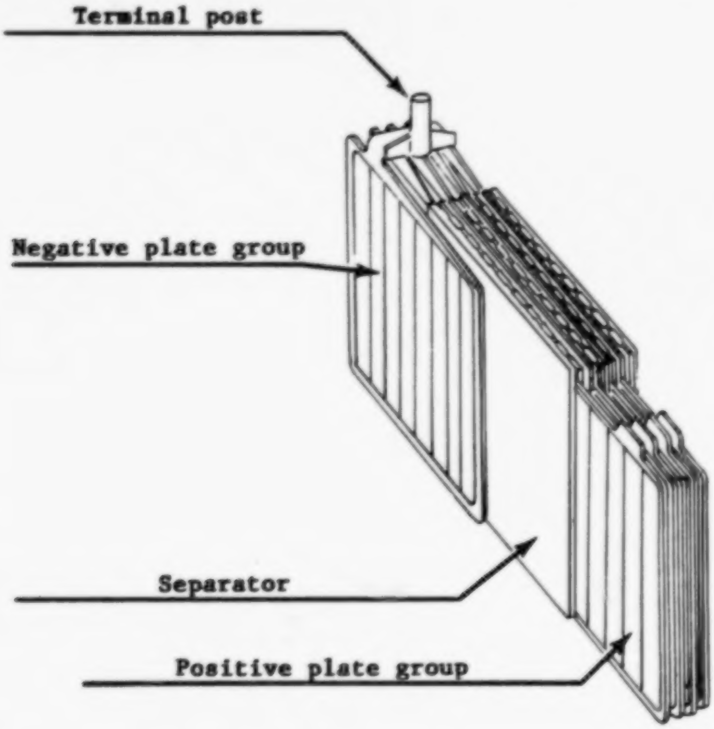
LAP ASSIGNMENT SHEET #1

4. Identify the parts of the battery cell shown below. Write the correct names of the parts in the blanks.



5. Explain the functions of the following battery parts.

   a. Separator--**Insulates negative plate from positive plate**

   b. Terminal post--**Provides a low-resistance battery cable connection**

   c. Battery case--**Holds cells and electrolyte to make up complete battery**

   d. Vent cap--**Closes each cell opening; provides vent to allow gases to escape**

   e. Post plate strap (plate strap casting)--**Connects plate group to terminal post**

LAP ASSIGNMENT SHEET #1

6. Fill in the missing words in the paragraph below.

When converting chemical energy into **electrical** energy, two **dissimilar** metals are placed in an **acid** solution. The more active metal will **lose** electrons and become **positively** charged. The less active metal will **accumulate** electrons and become **negatively** charged.

7. What factor affects battery voltage?

Number of cells that are connected in series

8. What factors affect battery capacity?

   a. **Number of cell plates**

   b. **Area of plate material**

   c. **Strength of electrolyte**

9. List and explain the three types of battery ratings.

   a. **Ampere-hour rating--Length of time in minutes that a fully charged battery at 80°F can deliver a specific quantity of current**

   b. **Cold-dranking rating--Number of amperes that a battery can deliver for 30 seconds at 0°F without cell voltage dropping below 1.2 volts per cell**

   c. **Peak watt rating (PWR)--Measure of cold cranking ability determined by multiplying maximum current by maximum voltage**

LAP ASSIGNMENT SHEET #1

10. List six battery safety rules.

    a. **Do not allow electrolyte to contact clothing, skin, eyes, or painted surfaces**

    b. **Keep flames and sparks away from battery**

    c. **Avoid shorting or grounding battery terminals during service**

    d. **Wear safety goggles and rubber gloves and aprons when servicing batteries**

    e. **Flush immediately with water any areas of skin contacted by acid**

    f. **Avoid breathing battery fumes**

11. List three advantages of the service-free battery.

    a. **Sealed case with a lifetime supply of electrolyte**

    b. **Special liquid-gas separator that returns electrolyte to reservoir**

    c. **Special plate material that reduces water loss, self-discharge, and overcharging**

12. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

    Refer to Information Sheet, Section(s)

_____ I	_____ V
_____ II	_____ VI
_____ III	_____ VII
_____ IV	_____ VIII

    If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 6.

SECTION B--ELECTRICAL SYSTEMS
UNIT II--BATTERY SERVICE

LAP ASSIGNMENT SHEET #2

NAME ______________________________ SCORE ____________________

1. Match the terms and definitions listed below. Write the correct numbers in the blanks.

5 a. Specific gravity
9 b. Electrolyte
1 c. Cell
2 d. Battery
3 e. Hydrometer
4 f. Sulfated
8 g. Battery rating
7 h. Dissimilar metals
6 i. Plate group

1. One positive and one negative plate group
2. Converts chemical energy into electricity
3. Measures specific gravity
4. Oxidation of positive plate grid wires
5. Comparison of liquid weight to an equal volume of distilled water
6. Similar plates welded to a plate strap
7. Not alike in substance or essentials
8. Maximum quantity of electricity that can be taken from a fully charged battery
9. Solution of 60 percent water and 40 percent sulfuric acid

2. List the three functions of the battery.

a. **Supplies current to crank engine**
b. **Supplies current when demand exceeds charging system output**
c. **Stabilizes voltage in the system during operation**

3. Explain the function of each of the following battery parts.

a. Battery case--**Holds cells and electrolyte**

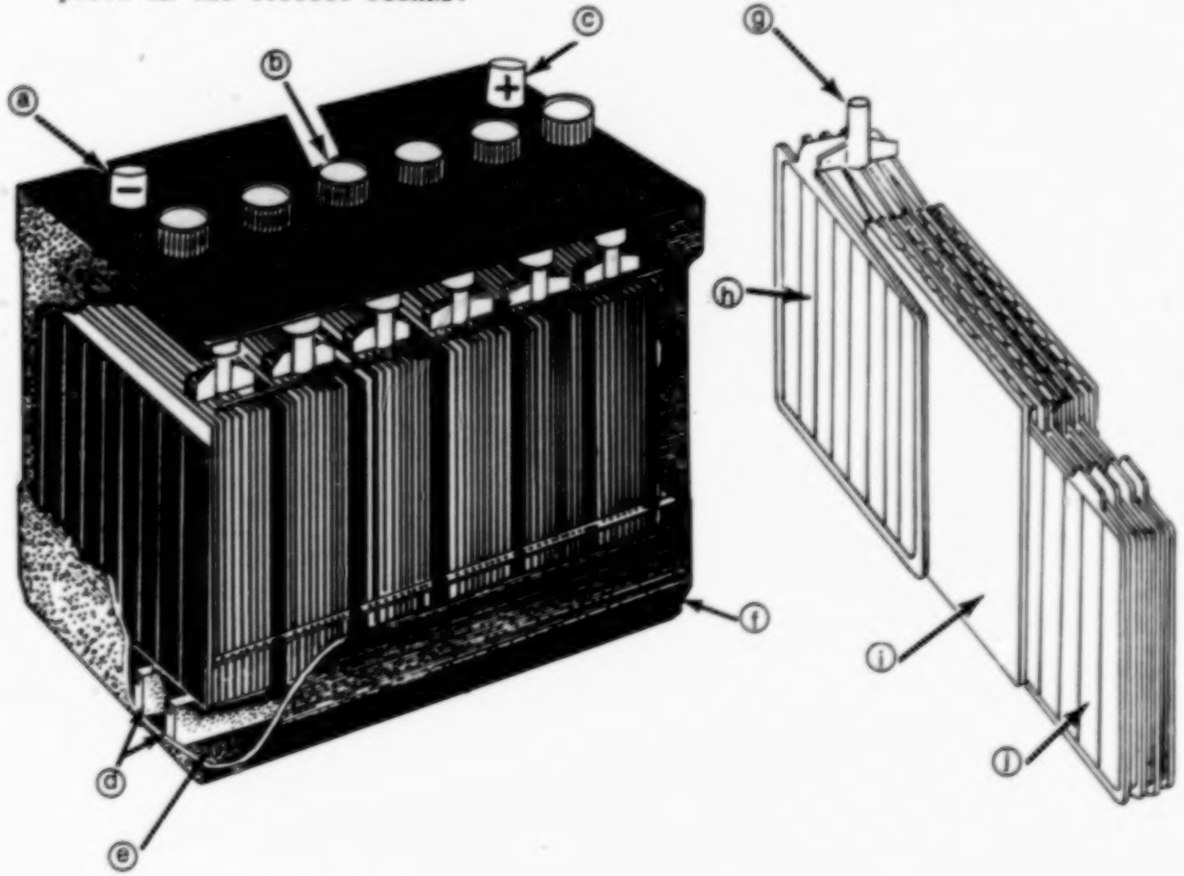
b. Vent cap--**Closes openings in cell covers; allows gases to escape**

c. Terminal post--**Provides low resistance battery cable connection**

d. Separator--**Insulates negative plate from positive plate**

e. Plate--**Group of plates welded together; store active material for chemical reaction**

4. Identify the parts of the battery and cell shown below. Write the names of the parts in the correct blanks.



a.	**Negative post**	f.	**Battery case**
b.	**Vent cap**	g.	**Terminal post**
c.	**Positive post**	h.	**Negative plate group**
d.	**Bridges**	i.	**Separator**
e.	**Sediment chamber**	j.	**Positive plate group**

LAP ASSIGNMENT SHEET #2

5. Explain how a battery converts chemical energy into electrical energy.

Chemical reaction is produced when two dissimilar metals are placed in acid solution. The more active metal loses electrons and becomes positively charged. The less active metal accumulates electrons and becomes negatively charged.

6. Fill in the missing words in the statements below.

Battery voltage is controlled by the number of **cells** in the battery. Battery capacity is determined by the number of **plates** in each cell, the area of **plate** material, and the strength of the **electrolyte** solution.

7. Match the battery ratings and their definitions. Write the correct numbers in the blanks.

2 a. Peak watt rating
3 b. Ampere-hour rating
1 c. Cold cranking rating

1. Number of amperes that a battery can deliver in 30 seconds at 0°F without cell voltage dropping below 1.2 volts
2. Determined by multiplying maximum voltage by maximum current
3. Length of time in minutes that a fully charged battery can deliver a specific amount of current

8. Special plate material, a gas-liquid separator, and a sealed case are three features of what type of battery?

Service-free

9. Fill in the missing words in the statements below.

    a. Always avoid contact with the electrolyte solution.

    b. Always wear goggles, rubber gloves, and rubber apron when servicing a battery.

    c. Avoid breathing battery fumes.

    d. Keep flames or sparks away from a battery.

10. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

State Department of Vocational and Technical Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. ______ CODE: ______

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT III--STARTING SYSTEMS

LEARNING ACTIVITY PACKET NO.	**PREREQUISITE LAP(S)**
11	9, 10

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Starting System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to state the purpose of the starting system, identify the components of the starting system and discuss the magnetic and operating principles of a starter. The student should also be able to perform starter system tests, bench tests, and repair a starter.

TASKS INCLUDED IN THIS LAP:

1. Load test a starter.
2. Test starter circuit resistance.
3. Test starter control circuit resistance.
4. Remove and replace a starter.
5. Disassemble, check, and reassemble a starter.
6. Disassemble and reassemble a gear reduction starter.

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SECTION B--ELECTRICAL SYSTEMS
UNIT III--STARTING SYSTEM

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read Unit and Specific Objectives, pages AM II-95-B and 96-B.

_____ 2. Complete Starting System Pretest, LAP page 11.

_____ 3. Study The sections of the Information Sheet, pages AM II-99-B through AM II-103-B, indicated by your instructor on your Pretest.

_____ 4. Refer To Step 13 of the Pretest. If additional study is required, continue to Learning Step 5. Otherwise, proceed to Learning Step 46.

_____ 5. Do LAP Assignment Sheet #1, LAP page 19.

_____ 6. Do LAP Assignment Sheet #2, LAP page 27.

_____ 7. Check The following tasks that you think you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Instructor Initials/Date Moderately Skilled
_____	a. Load test a starter. (10)	_____	_____
_____	b. Test starter circuit resistance. (16)	_____	_____

LEARNING STEPS

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____	c. Test starter control circuit resistance. (22)	___________	___________
_____	d. Remove and replace a starter. (28)	___________	___________
_____	e. Disassemble, check, and reassemble a starter. (34)	___________	___________
_____	f. Disassemble and reassemble a gear reduction starter. (40)	___________	___________

_____	8.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed by your instructor, proceed to Learning Step 46. Otherwise, continue to Learning Step 9.
_____	9.	Refer	To Learning Step 7a. If this task has been initialed by your instructor, proceed to Learing Step 15. Otherwise, continue to Learning Step 10.
_____	10.	Study	Job Sheet #1--Load Test a Starter, pages AM II-125-B and 126-B.
_____	11.	Watch	Slide/tape presentation, "Load Test a Starter." (B-III-1)
_____	12.	Do	Job Sheet #1--Load Test a Starter.
_____	13.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and proceed to Learning Step 15. Otherwise, repeat Learning Steps 10 through 12 and then continue to Learning Step 14.

LEARNING STEPS

_____14. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 15.

_____15. Refer To Learning Step 7b. If this task has been initialed by your instructor, proceed to Learning Step 21. Otherwise, continue to Learning Step 16.

_____16. Study Job Sheet #2--Test Starter Circuit Resistance, pages AM II-127-B through AM II-129-B.

_____17. Watch Slide/tape presentation, "Test Starter Circuit Resistance." (B-II-2)

_____18. Do Job Sheet #2--Test Starter Circuit Resistance.

_____19. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and then continue to Learning Step 20.

_____20. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and then continue to Learning Step 21.

LEARNING STEPS

_____21. Refer — To Learning Step 7c. If this task has been initialed by your instructor, proceed to Learning Step 27. Otherwise, continue to Learning Step 22.

_____22. Study — Job Sheet #3--Test Starter Control Circuit Resistance, pages AM II-131-B through AM II-133-B.

_____23. Watch — Slide/tape presentation, "Test Starter Control Circuit Resistance." (B-III-3)

_____24. Do — Job Sheet #3--Test Starter Control Circuit Resistance.

_____25. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and then continue to Learning Step 26.

_____26. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7c and then continue to Learning Step 27.

_____27. Refer — To Learning Step 7d. If this task has been initialed by your instructor, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.

_____28. Study — Job Sheet #4--Remove and Replace a Starter, pages AM II-135-B through AM II-137-B.

LEARNING STEPS

_____29. Watch Slide/tape presentation, "Remove and Replace a Starter." (B-III-4)

_____30. Do Job Sheet #4--Remove and Replace a Starter.

_____31. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and proceed to Learning Step 33. Otherwise, repeat Learning Steps 28 through 30 and then continue to Learning Step 32.

_____32. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7d and then continue to Learning Step 33.

_____33. Refer To Learning Step 7e. If this task has been initialed by your instructor, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.

_____34. Study Job Sheet #5--Disassemble, Check, and Reassemble a Starter, pages AM II-139-B through AM II-145-B.

_____35. Watch Slide/tape presentation, "Disassemble, Check, and Reassemble a Starter." (B-III-5)

_____36. Do Job Sheet #5--Disassemble, Check, and Reassemble a Starter.

LEARNING STEPS

_____37. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and proceed to Learning Step 39. Otherwise, repeat Learning Steps 34 through 36 and then continue to Learning Step 38.

_____38. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and continue to Learning Step 39. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7e and continue to Learning Step 39.

_____39. Refer To Learning Step 7f. If this task has been initialed by your instructor, proceed to Learning Step 45. Otherwise, continue to Learning Step 40.

_____40. Study Job Sheet #6--Disassemble and Reassemble a Gear Reduction Starter, pages AM II-147-B through 154-B.

_____41. Watch Slide/tape presentation, "Disassemble and Reassemble a Gear Reduction Starter." (B-III-6)

_____42. Do Job Sheet #6--Disassemble and Reassemble a Gear Reduction Starter.

_____43. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and proceed to Learning Step 45. Otherwise, repeat Learning Steps 40 through 42 and then continue to Learning Step 44.

LEARNING STEPS

_____44. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and continue to Learning Step 45. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7f and continue to Learning Step 45.

_____45. Refer To Learning Step 7. If all tasks have been initialed by your instructor, continue to Learning Step 46. Otherwise, refer to the step indicated in parentheses after the unsigned task.

_____46. Review Information Sheet (pages AM II-99-B through AM II-103-B) and LAP Assignment Sheets.

_____47. Take Starting Systems Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION B--ELECTRICAL SYSTEMS
UNIT III--STARTING SYSTEM

PRETEST

NAME ______________________________ SCORE ____________

DIRECTIONS: The purpose of this pretest is to determine how much you already know about the starting system. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may keep you from receiving needed instruction.

1. Define the following terms.

   a. Starter drive--**Device that transmits power from starter to the engine**

   b. Solenoid--**Tubular field coil used to close starter switch and engage starter drive with the flywheel**

   c. Brush--**Sliding contact that passes electrical current to the armature**

   d. Armature--**Series of wire loops arranged around a shaft; made to rotate in a magnetic field**

   e. Commutator--**Device used to reverse direction of current flow through conductors of an armature**

   f. Frame--**Housing for the starter; mounting for the field coils and pole shoes**

   g. Field coil--**Coil or winding that produces a magnetic field when current passes through it**

   h. Pole shoe--**Core inside a field coil, used to concentrate magnetic lines of force**

   i. Gear reduction starter--**Starter containing a set of gears designed to reduce cranking speed and increase torque**

PRETEST

2. State the purpose of the starting system.

    Starting system converts electrical energy from the battery into mechanical energy at the starter to crank the engine

3. Describe the operating principle of the starter.

    Starter is a small electrical motor with heavy windings of very low resistance that carries a high amperage current (150 to 250 amps) at a low voltage for a short period of time

4. Complete the following statements about magnetic principles of the starter.

    a. Like magnetic fields **repel** each other and opposite magnetic fields **attract** each other.

    b. **Current** **flow** creates a magnetic field around a conductor.

    c. The **stationary** field between the poles of a magnet interacts with the **magnetic** field around the conductor.

    d. Lines of force **oppose** each other on one side of a magnet and **reinforce** each other on the other side.

5. Fill in the missing words to complete the following statements about the path of current flow in a series-wound starter.

    a. High amperage current flows from **battery** to **starter** through heavy battery cable.

    b. Current enters the motor through a large cable **terminal** and travels through **field** **coils**.

    c. Field coils are connected to insulated **brushes** which pass current to **armature**.

    d. Current passes through **armature** **windings** and back to grounded **brushes**.

    e. **Grounded** **brushes** return current to **ground** and back to **battery**.

PRETEST

6. Identify the components of the starter system shown below. Write the correct names of the parts in the blanks.

   a. **Key switch**

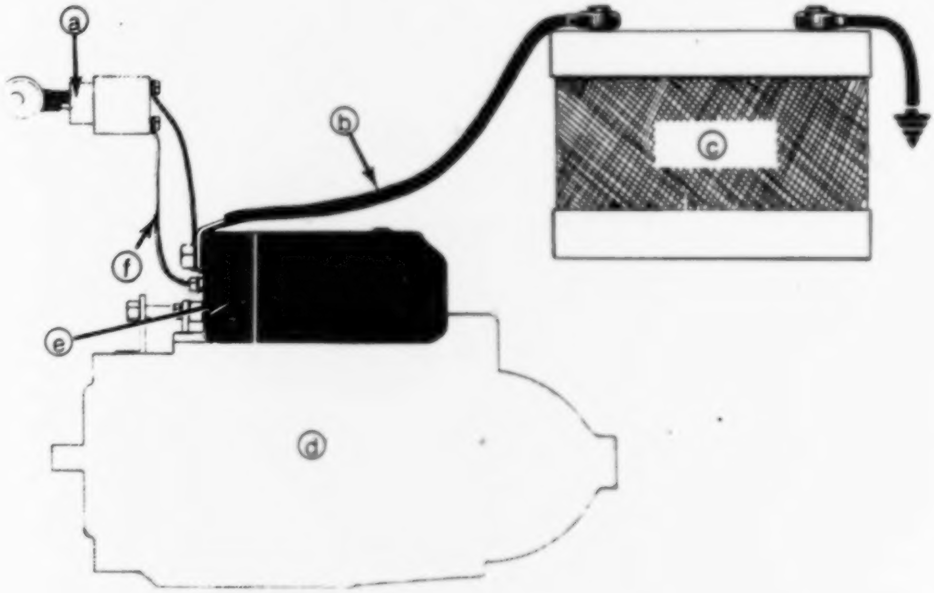
   b. **Battery cable**

   c. **Battery**

   d. **Starter**

   e. **Solenoid (starter switch)**

   f. **Small gauge switch wire**



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PRETEST

7. Name the two types of starter switches.

a. **Solenoid**

b. **Magnetic**

8. Identify the parts of the starter shown below. Write the correct names in the blanks.

a. **Starter brush**

b. **Starter frame**

c. **Through bolt**

d. **Solenoid**

e. **Shift lever**

f. **Drive housing**

g. **Starter drive**

h. **Field coil**

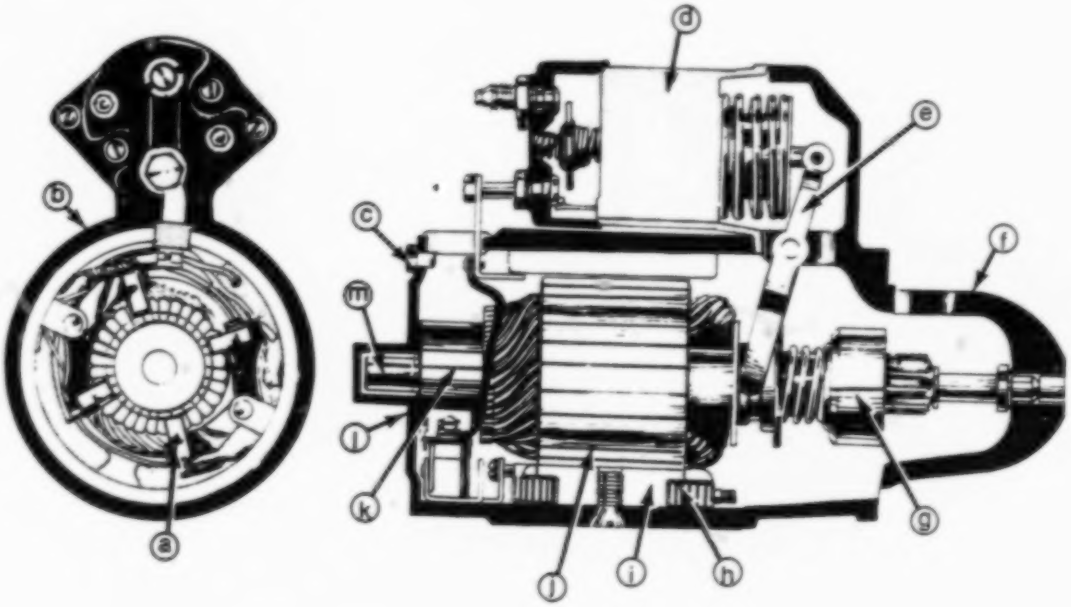
i. **Pole shoe**

j. **Armature**

k. **Commutator**

l. **End frame**

m. **Bushing**



PRETEST

9. Label the parts of the gear reduction starter. Write the correct names of the parts in the blanks.

a. **End frame**

b. **Starter frame**

c. **Starter field**

d. **Brush plate**

e. **Solenoid assembly**

f. **Solenoid moving core**

g. **Shifter fork**

h. **Clutch drive**

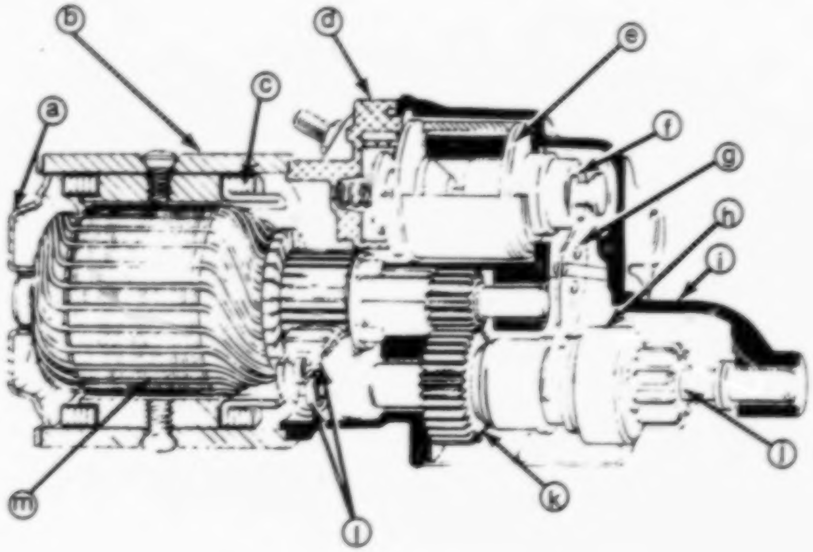
i. **Gear and solenoid housing**

j. **Pinion shaft**

k. **Reduction gear and gearset**

l. **Brush and spring**

m. **Armature**



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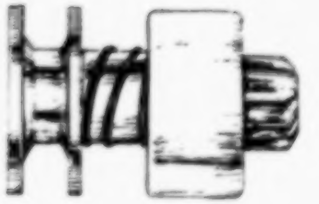
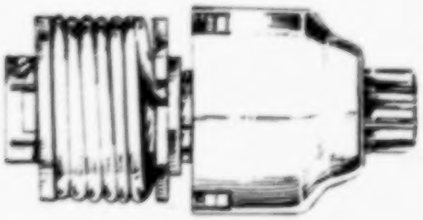
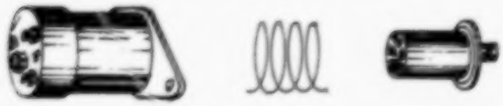
10. Identify the types of starter drives. Write the correct names in the blanks.

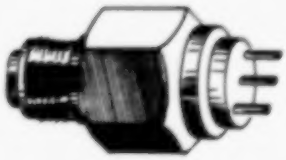




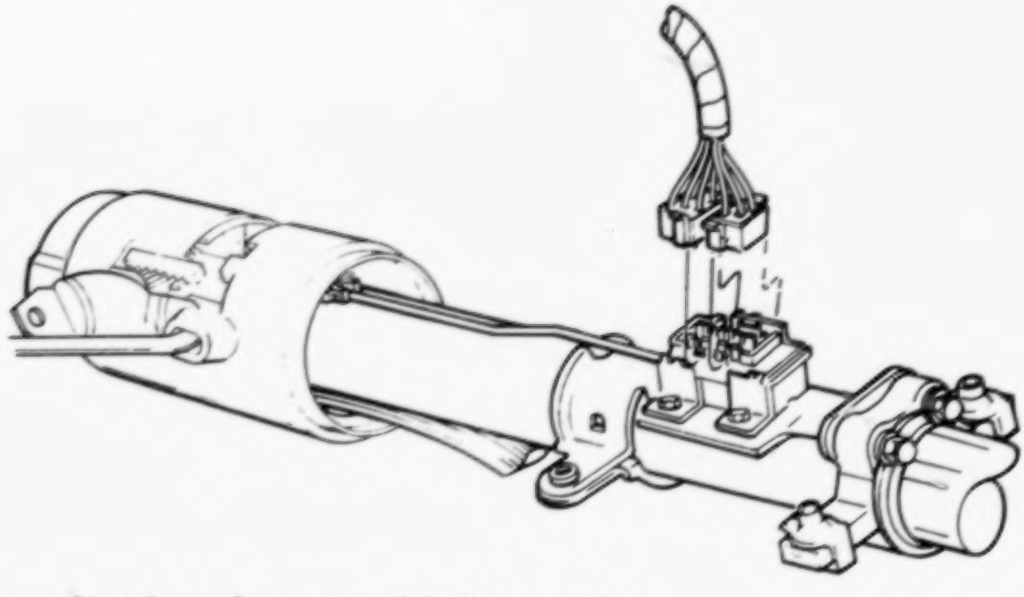
a. **Overrunning clutch** b. **Folo-thru Bendix**

11. Identify the components of the starter control circuit shown below. Write the correct names in the blanks.

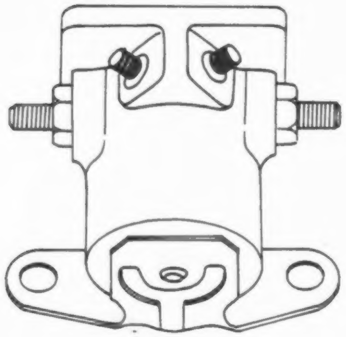


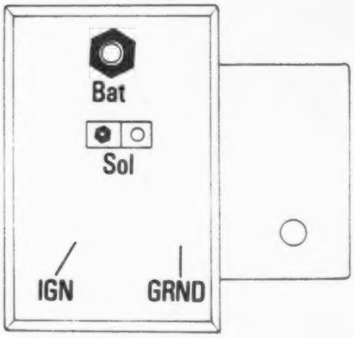


a. **Solenoid** b. **Transmission-mounted neutral-start switch**



c. **Steering column mounted ignition switch**





d. **Magnetic switch**

e. **Starter relay**

12. Describe the function of each starter control circuit component listed below.

a. Ignition switch-- **Initiates current to control circuit**

b. Neutral-start switch-- **Opens control circuit when automatic transmission is out of neutral or park**

c. Seat-belt starter interlock system-- **Opens starter control circuit when passengers in front seat do not connect seat belts**

d. Starter relay-- **Connects starter solenoid to battery when its contacts close**

e. Starter solenoid-- **Shifts starter drive gear in mesh with flywheel and closes heavy contact switch between battery and starter**

f. Magnetic starter switch--**Closes circuit between battery and starter**

PRETEST

13. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____ I

_____ II

_____ III

_____ IV

_____ V

_____ VI

_____ VII

_____ VIII

_____ IX

_____ X

_____ XI

_____ XII

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION B--ELECTRICAL SYSTEMS
UNIT III--STARTING SYSTEM

LAP ASSIGNMENT SHEET #1

NAME ______________________________ SCORE ______________

1. Match the terms and definitions listed below. Write the correct numbers in the blanks.

5 a. Frame

9 b. Solenoid

8 c. Brush

7 d. Field coil

2 e. Armature

1 f. Pole shoe

3 g. Starter drive

6 h. Gear reduction starter

4 i. Commutator

1. Series of wire loops around a shaft
2. Device that reverses direction of current flow through armature
3. Device that uses gears to increase torque and reduce cranking speed
4. Device that transmits starter motor power from flywheel to engine
5. Field coil used to engage starter drive with flywheel
6. Housing for starter; mounting for field coils and pole shoes
7. Sliding contact that passes current to armature
8. Metal core of field coil
9. Winding that produces a magnetic field

2. Fill in the missing words in the following sentences.

a. The purpose of the starting system is to convert electrical energy from the **battery** into mechanical energy at the **starter** to crank the engine.

b. The operating principle of the starter is that a small electric **motor** with heavy **windshield** carries a high **amperage** current and a low **voltage** for a short period of time.

LAP ASSIGNMENT SHEET #1

3. List the four magnetic principles of the starter.

   a. Like poles repel and unlike poles attract

   b. Current flow in a conductor creates a magnetic field

   c. Stationary field between poles interacts with conductor's magnetic field

   d. Lines of force oppose each other on one side of the conductor and reinforce each other on the other side

4. Fill in the missing words in the following paragraph.

The high amperage current from the battery flows to the starter through the heavy cable. Current enters the motor at the cable terminal and travels through the field coils. The field coils are connected to the insulated brushes, which pass current to the armature. Current passes through the armature windings, back to the grounded brushes, to the ground, and back to the battery.

PRETEST

5. Identify the labeled parts of the starter system shown below. Write the correct names of the parts in the blanks.

a. **Battery**

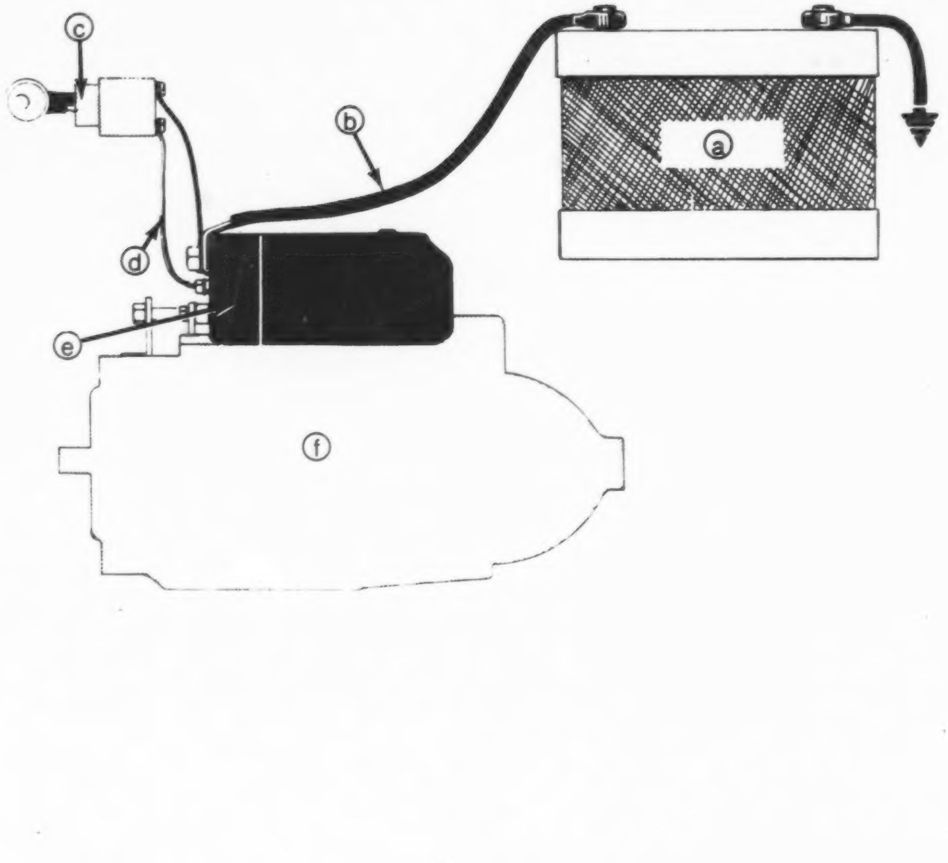
b. **Battery cable**

c. **Key switch**

d. **Switch wire**

e. **Starter switch (solenoid)**

f. **Starter**



LAP ASSIGNMENT SHEET #1

6. Explain the function of each of the following starting system components.

   a. Battery-- **Source of electrical power**

   b. Key switch-- **Activates starter switch**

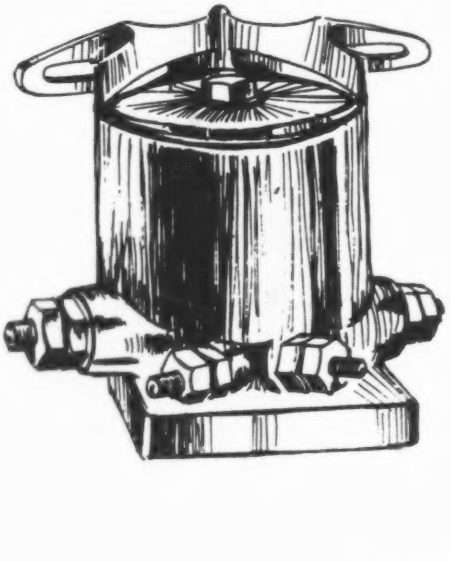
   c. Starter-- **Drives flywheel**

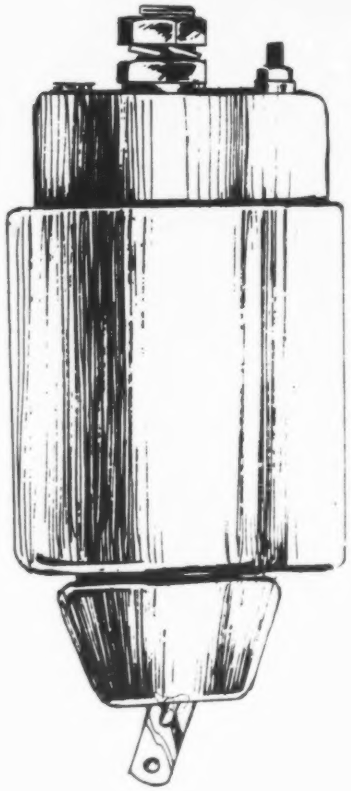
   d. Switch wire-- **Carries current to starter switch**

   e. Starter switch-- **Engages drive gear; closes circuit from battery to starter**

   f. Battery cables-- **Carry battery current to the starter**

7. Identify the two types of starter switches. Write the correct names in the blanks.





a. **Magnetic**

b. **Solenoid**

LAP ASSIGNMENT SHEET #1

8. Identify the labeled parts of the starter. Write the correct names of the parts in the blanks.

a. **Solenoid**

b. **Shift lever**

c. **Drive housing**

d. **Starter drive**

e. **Field coil**

f. **Pole shoe**

g. **Armature**

h. **Commutator**

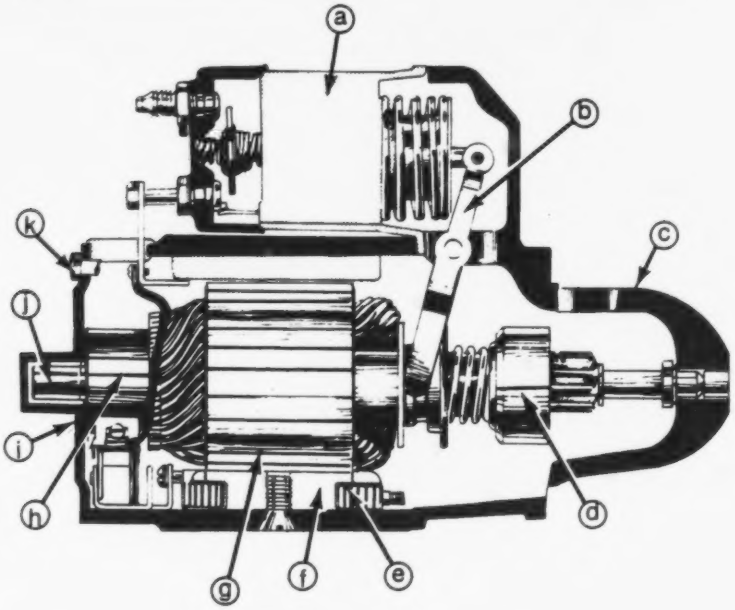
i. **End frame**

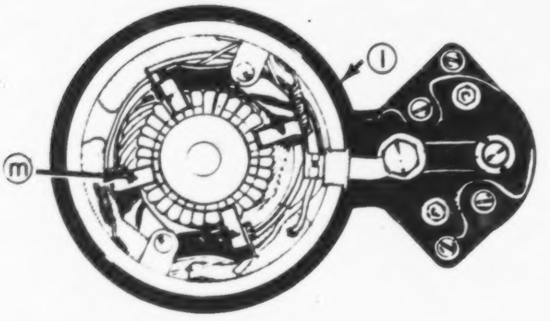
j. **Bushing**

k. **Through bolt**

l. **Starter frame**

m. **Starter brush**





LAP ASSIGNMENT SHEET #1

9. Label the parts of the gear reduction starter. Write the correct names of the parts in the blanks.

a. **Armature**

b. **Brush and spring**

c. **Reduction gear and gearset**

d. **Pinion shaft**

e. **Gear and solenoid housing**

f. **Cluth drive**

g. **Shifter fork**

h. **Solenoid moving core**

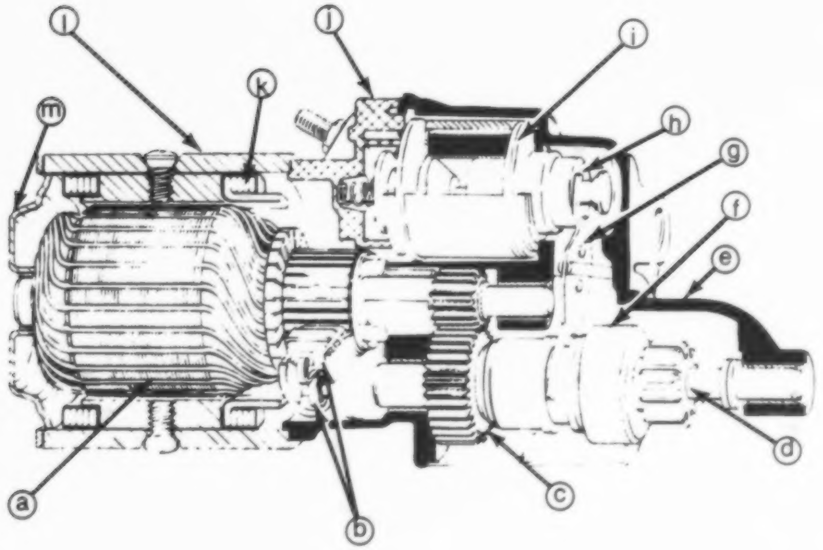
i. **Solenoid assembly**

j. **Brush plate**

k. **Starter field**

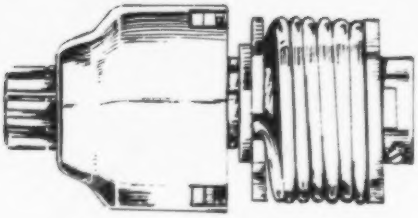
l. **Starter frame**

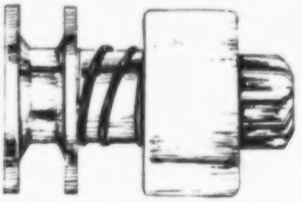
m. **End frame**



LAP ASSIGNMENT SHEET #1

10. Identify the starter drives shown below. Write the correct names in the blanks.

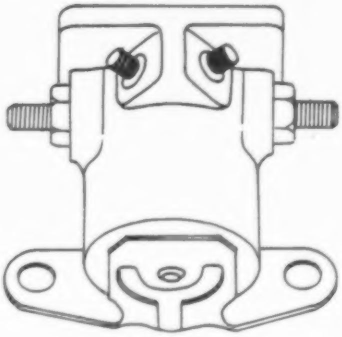




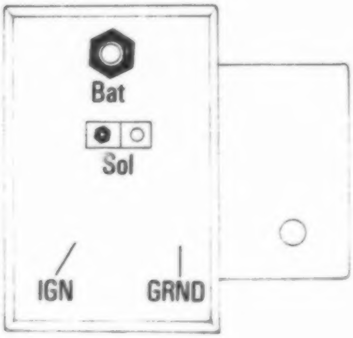
a. **Folo-thru bendix**

b. **Overrunning clutch**

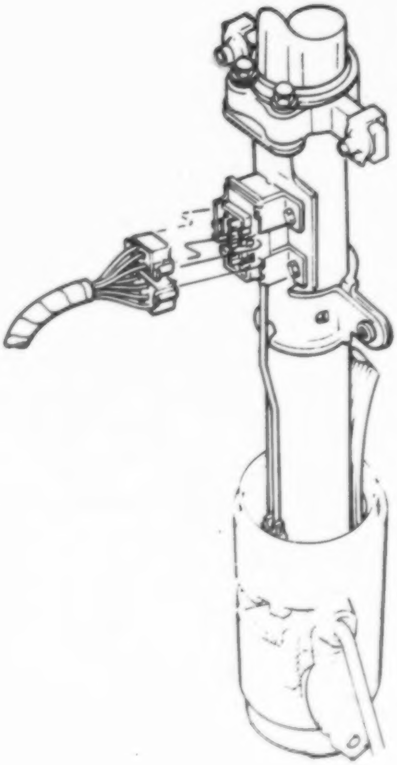
11. Identify the following starter control circuit components. Write the correct names in the blanks.



a. **Magnetic switch**

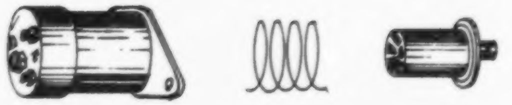


b. **Starter relay**

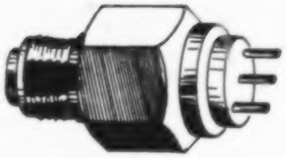


c. **Steering column ignition switch**

LAP ASSIGNMENT SHEET #1



d. **Solenoid**



e. **Neutral-start switch**

12. Explain the function of each component of the starter control circuits listed below.

    a. Ignition switch--**Initiates control circuit current**

    b. Neutral-start switch--**Allows complete control circuit only with transmission in neutral or park**

    c. Seat-belt interlock--**Prevents starting engine unless front seat passengers fasten their belts**

    d. Starter relay--**Connects solenoid and battery when its contacts close**

    e. Solenoid--**Shifts starter gear into drive position and completes high amp circuit between battery and starter**

    f. Magnetic starter switch--**Completes circuit between battery and starter**

13. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

    Refer to Information Sheet, Section(s)

    ____ I
    ____ II
    ____ III
    ____ IV
    ____ V
    ____ VI
    ____ VII
    ____ VIII
    ____ IX
    ____ X
    ____ XI
    ____ XII

    If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 6.

LAP ASSIGNMENT SHEET #2

NAME ____________________ SCORE __________

1. Define the following terms.

   a. Commutator--**Device that reverses the current flow in a rotating armature**

   b. Gear reduction starter--**Starter that uses a set of gears to reduce cranking speed and increase torque**

   c. Frame--**Housing for starter and mounting for field coils and pole shoes**

   d. Solenoid--**Field coil used to engage starter drive with the flywheel and to close the starter switch**

   e. Brush--**Sliding contact that passes current to armature**

   f. Pole shoe--**Metal core of a field coil used to concentrate magnetic lines of force**

   g. Armature--**Wire windings arranged around a shaft**

   h. Field coil--**Winding in a generator or starter, that produces a magnetic field when a current passes through it**

   i. Starter drive--**Device that transmits force of the starter to the engine**

2. State the purpose of the starting system.

   Converts electrical energy from the battery into mechanical energy at the starter to crank the engine.

LAP ASSIGNMENT SHEET #2

3. State the operating principle of the starter.

A small electric motor with heavy windings and low resistance carries a high amperage current at low voltage for a short period of time.

4. Fill in the missing words in the paragraph below.

Like magnetic fields **repel** each other while unlike fields **attract**. Current flow in a conductor creates a **magnetic field** around the conductor. Stationary field between **poles** of the magnet interacts with magnetic field around **conductor**. Line of force will **oppose** each other on one side of the conductor and **reinforce** each other on the opposite side.

5. Describe the path of current flow in a series wound starter.

High amp current flows from battery to starter through cable.

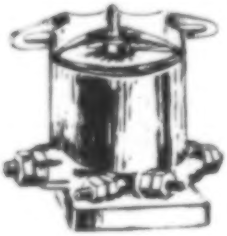
Current enters motor and travels through field coils.

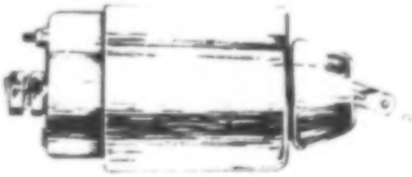
Current passes through brushes to the armature.

Current passes through armature windings and back to brushes.

Grounded brushes return current to ground and back to the battery.

6. Identify the starter switches shown below.



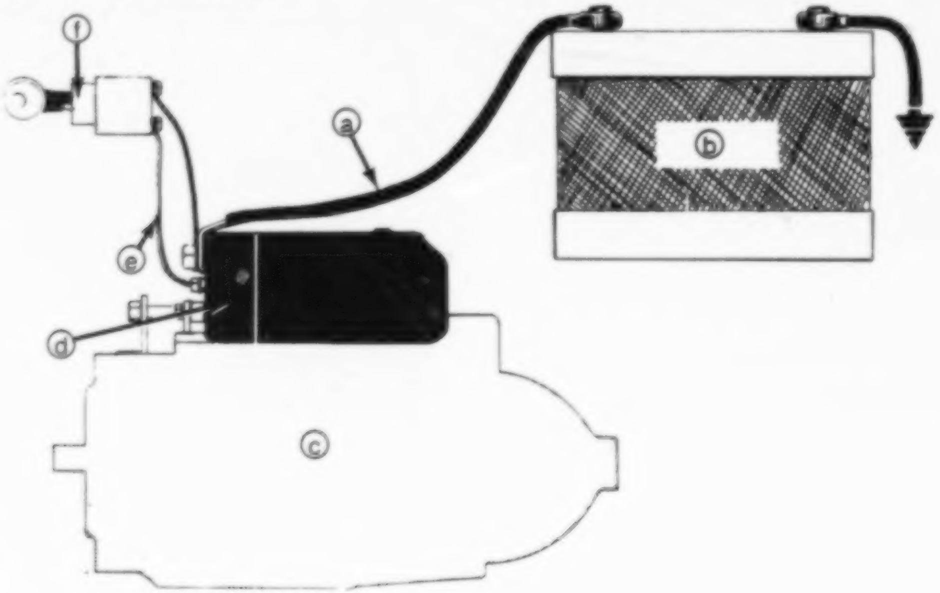


a. **Magnetic**

b. **Solenoid**

LAP ASSIGNMENT SHEET #2

7. Identify and explain the functions of the labeled parts of the starter system shown below. Write the name of each part beside the correct letter and explain its function.



a. Battery cable--carries high amp current from battery to the starter

b. Battery--Source of electrical power for the starter

c. Starter--converts electricity into mechanical energy to crank the engine

d. Starter switch--completes circuit between battery and starter

e. Small gauge switch wire--Carries current to starter switch (solenoid)

f. Key switch--activates starter switch

LAP ASSIGNMENT SHEET #2

8. Match the names of parts of the starter and their locations on the illustration below. Write the correct letters in the blanks.

m Starter brush

f Armature

k Shift lever

l Starter frame

c Bushing

g Pole shoe

h Field coil

e Commutator

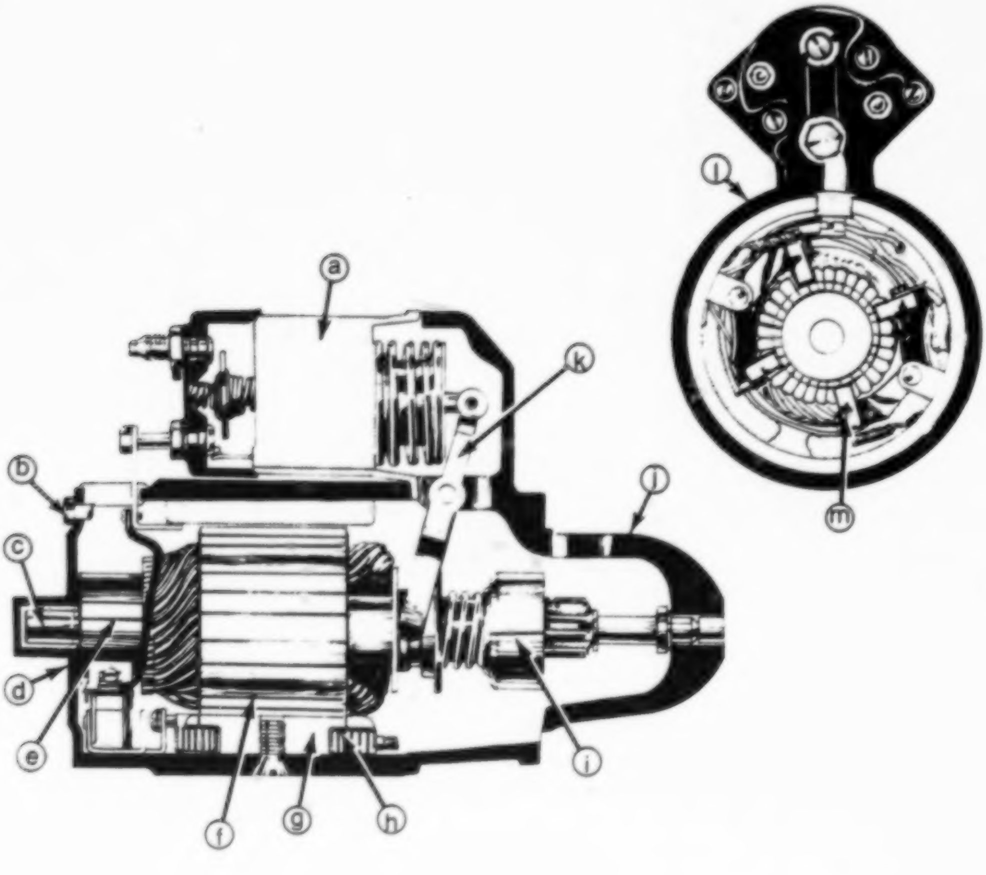
i Starter drive

a Solenoid

d End frame

b Through bolt

j Drive housing



LAP ASSIGNMENT SHEET #2

9. Match the names of parts of the gear reduction starter and their locations on the illustration below.

f Brush and spring

g Reduction gear and gearset

m Solenoid assembly

e Armature

d End frame

c Starter frame

a Brush plate

h Pinion shaft

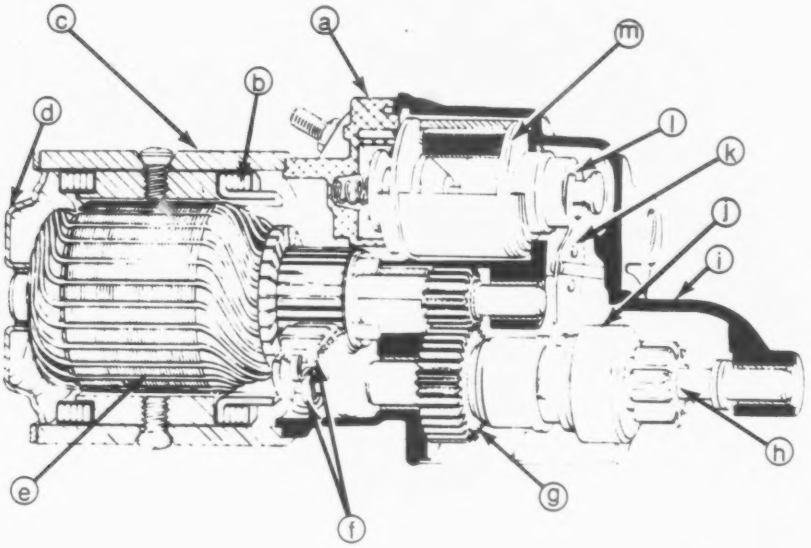
j Clutch drive

l Solenoid moving core

b Starter field

i Gear and solenoid housing

k Shifter fork



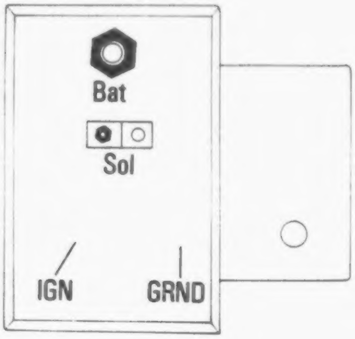
10. Name the two types of starter drives.

a. **Folo-thru bendix**

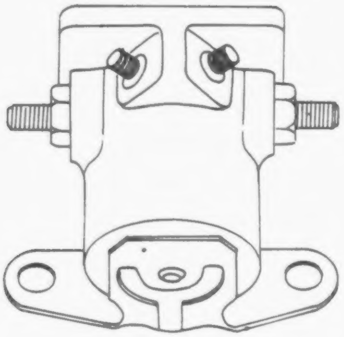
b. **Overrunning clutch**

LAP ASSIGNMENT SHEET #2

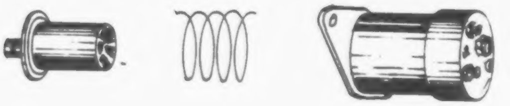
11. Label the components of a starter control circuit. Write the correct names in the blanks.



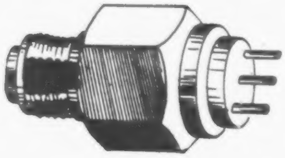
a. **Starter relay**



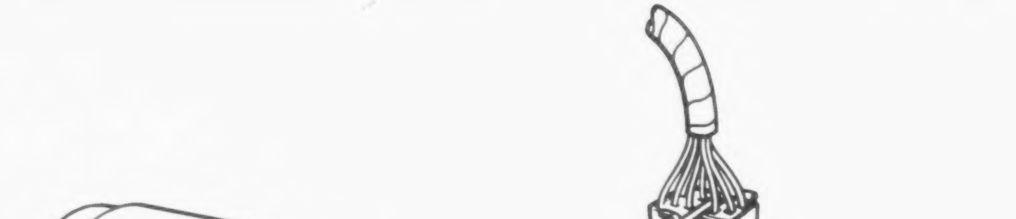
b. **Magnetic switch**



c. **Solenoid**



d. **Neutral-start switch**



e. **Ignition switch (steering column)**

LAP ASSIGNMENT SHEET #2

12. Match the starter control circuit components to their proper functions. Write the correct numbers in the blanks.

1 a. Starter relay
3 b. Neutral-start switch
5 c. Solenoid
2 d. Ignition switch
4 e. Magnetic starter switch
6 f. Seat belt interlock

1. Connects solenoid and battery
2. Shifts starter drive into position
3. Completes circuit between starter and battery
4. Completes control circuit only when vehicle is in neutral
5. Initiates control circuit current
6. Completes control circuit only when front seat belts are fastened

13. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

State Department of Vocational and Technical Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. ________ CODE: ________

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT IV--IGNITION SYSTEM

LEARNING ACTIVITY PACKET NO. 12 **PREREQUISITE LAP(S)** 9, 10

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Ignition System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify components of the various ignition systems, their functions, and the overall operation of the ignition system. The student should also be able to service the ignition system.

TASKS INCLUDED IN THIS LAP:

1. Check and set ignition timing.
2. Remove and replace a distributor.
3. Remove and replace contact points and condenser.
4. Adjust dwell on an externally adjustable distributor.
5. Test and adjust distributor on distributor tester.
6. Remove, inspect, service, and replace spark plugs.

LEARNING STEPS

Check the following
blanks as you complete
the required steps.

_____ 1. Read Unit and Specific Objectives, page AM II 165-B.

_____ 2. Complete Ignition System Pretest, LAP page 11.

_____ 3. Study The sections of the Information Sheet, pages AM II 169-B through AM II 175-B, indicated by your instructor on your pretest.

_____ 4. Refer To Step 18 of your Pretest. If additional study is required, continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do LAP Assignment Sheet #1, LAP page 21.

_____ 6. Do LAP Assignment Sheet #2, LAP page 31.

_____ 7. Check The following tasks that you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Check and set ignition timing. (10)	_________	_________
_____b.	Remove and replace a distributor. (16)	_________	_________
_____c.	Remove and replace contact points and condenser. (22)	_________	_________

LEARNING STEPS

Student Check		Instructor Initials/Date Skilled	 Moderately Skilled
_____d.	Adjust dwell on an externally adjustable distributor. (28)	_________	_________
_____e.	Test and adjust distributor on distributor tester. (34)	_________	_________
_____f.	Remove, inspect, service, and replace spark plugs. (40)	_________	_________

_____ 8. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed by your instructor, proceed to Learning Step 46. Otherwise, continue to Learning Step 9.

_____ 9. Refer — To Learning Step 7a. If this task has been initialed by your instructor, proceed to Learning Step 15. Otherwise, continue to Learning Step 10.

_____10. Study — Job Sheet #1--Check and Set Ignition Timing, pages AM II 205-B through AM II 207-B.

_____11. Watch — Slide/tape presentation, "Check and Set Ignition Timing." (B-IV-1)

_____12. Do — Job Sheet #1--Check and Set Ignition Timing.

_____13. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and proceed to Learning Step 15. Otherwise, repeat Steps 10 through 12 and then continue to Learning Step 14.

LEARNING STEPS

_____14.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and then continue to Learning Step 15.
_____15.	Refer	To Learning Step 7b. If this task has been initialed by your instructor, proceed to Learning Step 21. Otherwise, continue to Learning Step 16.
_____16.	Study	Job Sheet #2--Remove and Replace a Distributor, pages AM II 209-B through 212-B.
_____17.	Watch	Slide/tape presentation, "Remove and Replace a Distributor." (B-IV-2)
_____18.	Do	Job Sheet #2--Remove and Replace a Distributor.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and then continue to Learnng Step 20.
_____20.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and then continue to Learning Step 21.

LEARNING STEPS

_____21. Refer — To Learning Step 7c. If this task has been initialed by your instructor, proceed to Learning Step 27. Otherwise, continue to Learning Step 22.

_____22. Study — Job Sheet #3--Remove and Replace Contact Points and Condenser, pages AM II 213-B through 216-B.

_____23. Watch — Slide/tape presentation, "Remove and Replace Contact Points and Condenser." (B-IV-3)

_____24. Do — Job Sheet #3--Remove and Replace Contact Points and Condenser.

_____25. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and then continue to Learning Step 26.

_____26. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7c and then continue to Learning Step 27.

_____27. Refer — To Learning Step 7d. If this task has been initialed by your instructor, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.

_____28. Study — Job Sheet #4--Adjust Dwell on an Externally Adjustable Distributor, pages AM II 217-B and 218-B.

LEARNING STEPS

_____29. Watch Slide/tape presentation, "Adjust Dwell on an Externally Adjustable Distributor." (B-IV-4)

_____30. Do Job Sheet #4--Adjust Dwell on an Externally Adjustable Distributor.

_____31. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and proceed to Learning Step 33. Otherwise, repeat Learning Steps 28 through 30 and then continue to Learning Step 32.

_____32. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7d and then continue to Learning Step 33.

_____33. Refer To Learning Step 7e. If this task has been initialed by your instructor, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.

_____34. Study Job Sheet #5--Test and Adjust Distributor on Distributor Tester, pages AM II 219-B through 230-B.

_____35. Watch Slide/tape presentation, "Test and Adjust Distributor on Distributor Tester." (B-IV-5)

_____36. Do Job Sheet #5--Test and Adjust Distributor on Distributor Tester.

LEARNING STEPS

_____37. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and proceed to Learning Step 39. Otherwise, repeat Learning Steps 34 through 36 and then continue to Learning Step 38.

_____38. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and then continue to Learning Step 39. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7e and then continue to Learning Step 39.

_____39. Refer To Learning Step 7f. If this task has been initialed by your instructor, proceed to Learning Step 45. Otherwise, continue to Learning Step 40.

_____40. Study Job Sheet #6--Remove, Inspect, Service, and Replace Spark Plugs, pages AM II 231-B through 234-B.

_____41. Watch Slide/tape presentation, "Remove, Inspect, Service, and Replace Spark Plugs." (B-IV-6)

_____42. Do Job Sheet #6--Remove, Inspect, Service, and Replace Spark Plugs.

_____43. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and proceed to Learning Step 45. Otherwise, repeat Learning Steps 40 through 42 and then continue to Learning Step 44.

LEARNING STEPS

_____44. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and then continue to Learning Step 45. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7f and then continue to Learning Step 45.

_____45. Refer To Learning Step 7. If all tasks have been initialed by your instructor, continue to Learning Step 46. Otherwise, refer to the step indicated in parentheses after the unsigned task.

_____46. Review Information Sheet (pages AM II 169-B through AM II 175-B) and LAP Assignment Sheets.

_____47. Take Ignition System Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

PRETEST

NAME ____________________ SCORE ____________

DIRECTIONS: The purpose of this pretest is to determine how much you already know about the ignition system. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet _your_ needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. Primary ignition circuit--**Low-voltage circuit that energizes ignition coil**

   b. Electronic ignition system--**System that uses a control unit and magnetic pickup to control opening and closing of primary circuit**

   c. Dwell--**Number of degrees of distributor cam rotation that ignition points are closed**

   d. Timing--**Ignition of the fuel-air mixture at the exact moment for maximum power**

   e. Ignition bypass circuit--**Auxiliary primary ignition circuit; bypasses resistance unit for full battery voltage to ignition system during starting**

   f. Secondary ignition circuit--**High-voltage circuit that produces current to jump spark plug gap**

2. Explain the basic purpose of the ignition system.

   To provide a high-voltage spark to ignite the fuel-air mixture in the combustion chamber.

PRETEST

3. Identify the parts of the ignition system shown below. Write the correct names of the parts in the corresponding blanks.

a. **Spark advance mechanism**

b. **Condenser**

c. **Contact points**

d. **Breaker cam**

e. **Rotor**

f. **Secondary ignition cable**

g. **Primary ignition wire**

h. **Ignition coil**

i. **Distributor cap**

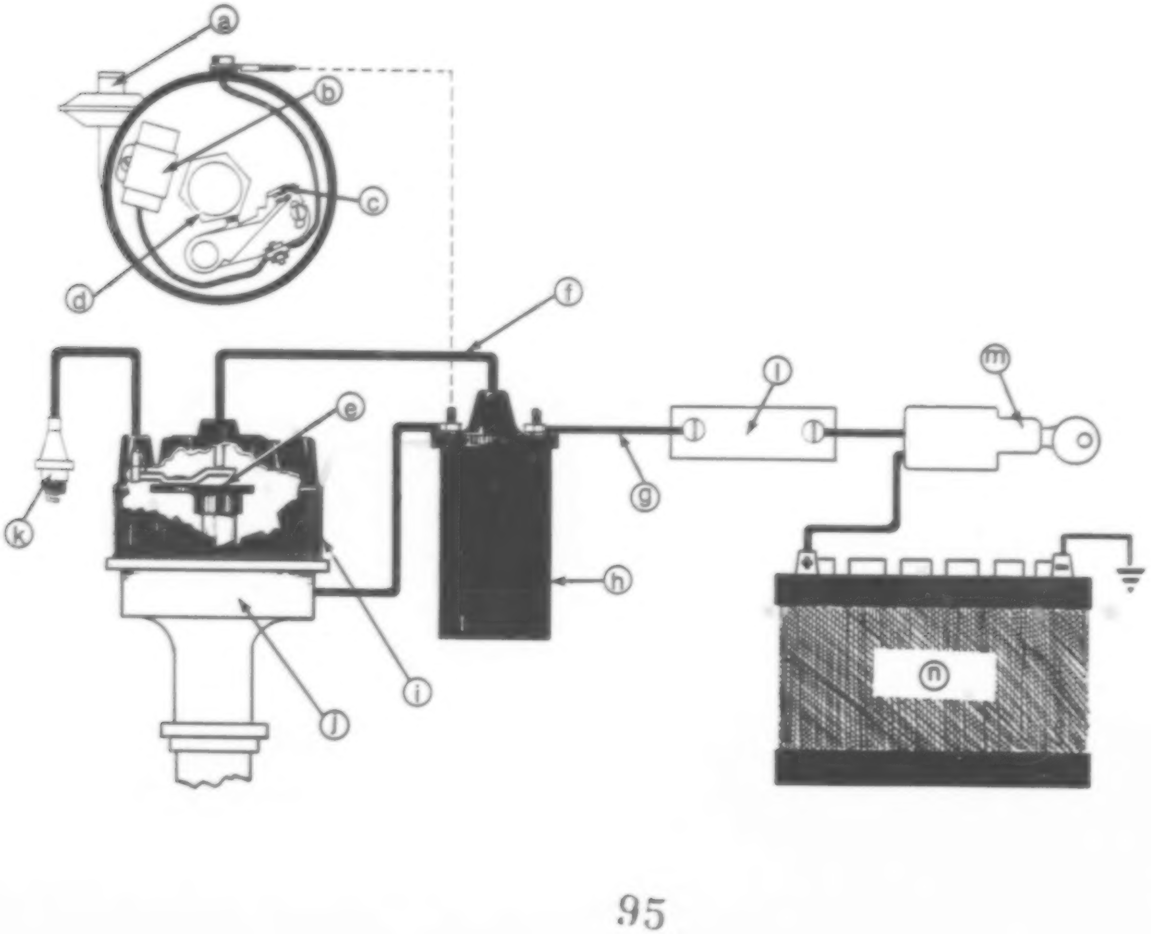
j. **Distributor**

k. **Spark plug**

l. **Primary resistance unit**

m. **Ignition switch**

n. **Battery**



4. Describe the functions of the following ignition system components.

   a. Battery--**Source of electrical power**

   b. Condenser--**Stores extra current; prevents arcing as contact points open**

   c. Distributor--**Contains contact points and condenser; routes high-voltage current from the coil to the proper cylinder**

   d. Spark plug--**Provides the spark to ignite the fuel-air mixture in the cylinder**

   e. Spark-advance mechanism--**Regulates timing of high-voltage circuit for best ignition at all engine speeds and loads**

   f. Primary ignition wire--**Carries low voltage from battery to primary coil windings**

   g. Breaker cam--**Opens and closes contact points**

   h. Ignition switch--**Opens and closes primary circuit between battery and coil**

   i. Rotor--**Directs voltage from the coil to the correct cylinder**

   j. Resistance unit--**Reduces voltage in primary circuit to protect the points**

   k. Secondary ignition cable--**Carries high voltage from coil to spark plug**

   l. Contact points--**Opens and closes primary circuit to allow coil to produce high voltage at the spark plugs**

PRETEST

m. Distributor cap--**Weatherproof cap that holds coil and spark plug wires in sequence**

n. Ignition coil--**Transforms voltage needed to jump the spark plug gap**

5. Identify the components of the distributor shown below. Write the correct names of the parts in the corresponding blanks. .

a. **Centrifugal advance mechanism**

b. **Condenser**

c. **Vacuum advance unit**

d. **Distributor cam**

e. **Primary lead wire**

f. **Breaker plate**

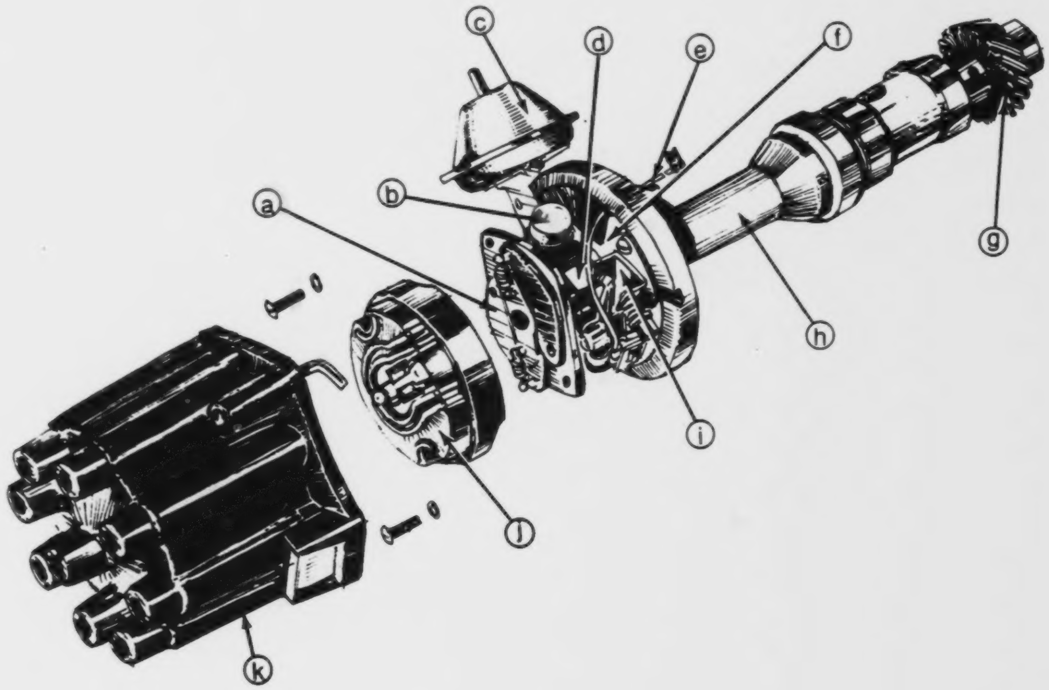
g. **Distributor cap**

h. **Rotor**

i. **Contact points**

j. **Distributor housing**

k. **Distributor drive gear**



PRETEST

6. Below are listed components of ignition system circuits. In the blank before each component, write "P" for primary ignition system circuit or "S" for secondary ignition system circuit.

P a. Low voltage wire

S b. Spark plug

P c. Ignition switch

P d. Condenser

S e. Distributor cap

P f. Contact points

S g. Rotor

P h. Resistance unit

P i. Primary winding of the coil

S j. Secondary winding of the coil

S k. High voltage cable

P l. Battery

7. Arrange in order steps in the operation of the ignition system. Write a "1" before the first step, a "2" before the second step, and so on.

5 a. High voltage surge is directed from secondary coil windings, through distributor cap and rotor, on to spark plug, and to ground

2 b. Magnetic field buildup is caused by flow of low voltage current through primary coil windings

1 c. Low voltage current flows from battery, through primary coil winding, through contact points, and to ground while ignition switch is on and contact points are closed

4 d. High voltage surge is caused when current flow is stopped and magnetic field of the coil primary windings collapses across secondary coil windings

3 e. Current flows across point surfaces as contact points open and is then absorbed by condenser

8. Identify the parts of the spark plug shown below. Write the correct names of the parts in the corresponding blanks.

a. **Center electrode tip**

b. **Gas seal**

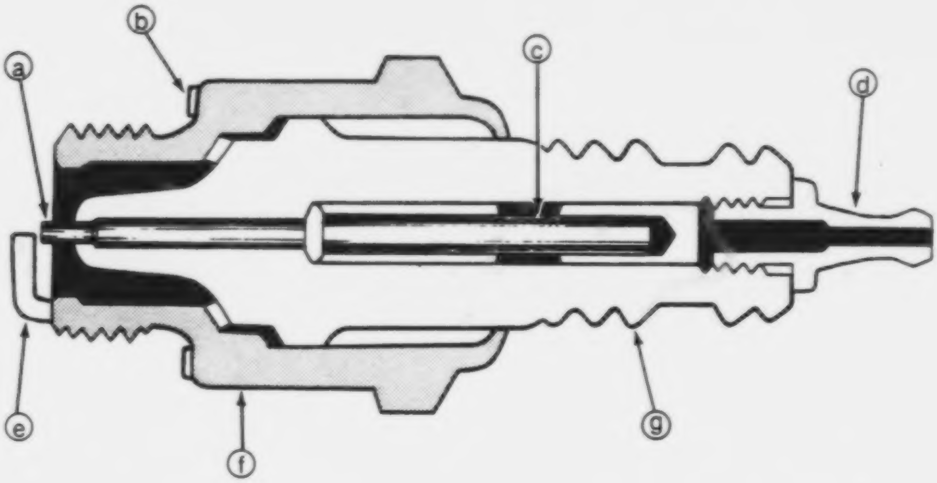
c. **Center electrode resistance unit**

d. **Ignition cable terminal**

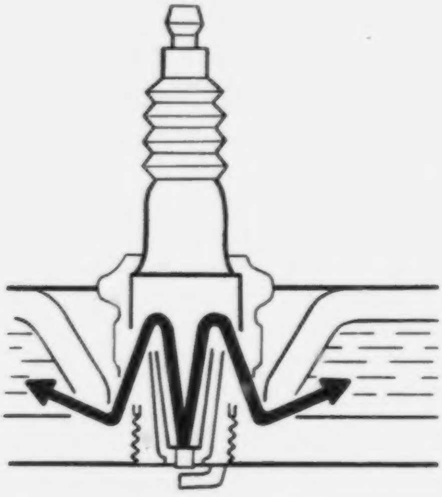
e. **Ground electrode**

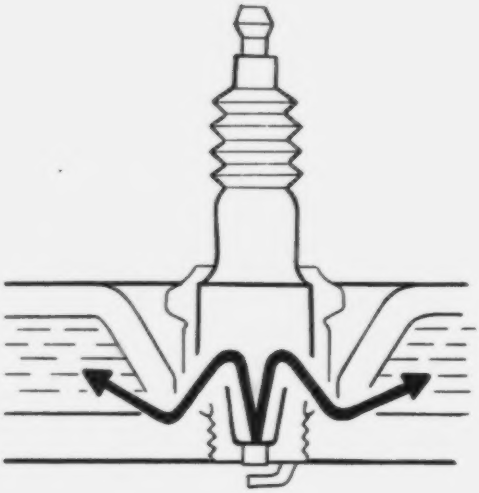
f. **Steel shell**

g. **Porcelain Insulator**



9. Identify each spark plug shown below according to heat range. Write "hot" or "cold" in the blanks below the drawings.



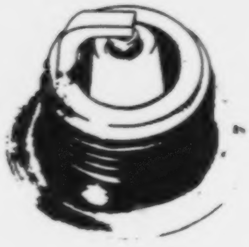


a. **Hot**

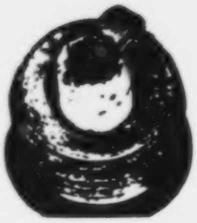
b. **Cold**

PRETEST

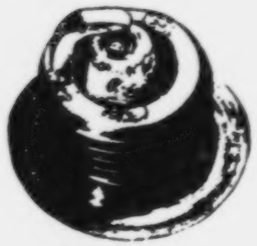
10. Identify the spark plug conditions shown below. Write the conditions in the blanks below the drawings.



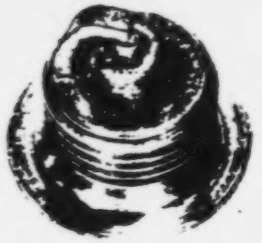
a. **Normal**



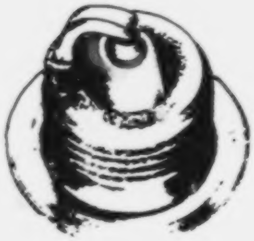
b. **Preignition**



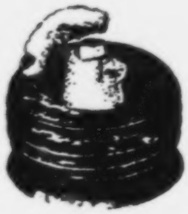
c. **Hot**



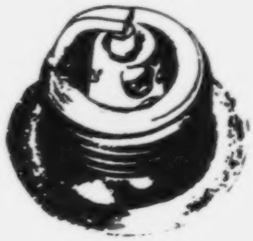
d. **Oil deposits**



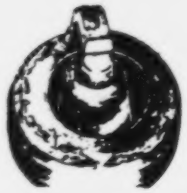
e. **Carbon deposits**



f. **Modifier deposits**



g. **Splashed deposits**



h. **High-speed glazing**

11. Name the two types of secondary ignition cables.

a. **Radio suppression**

b. **Stranded wire**

12. Fill in the missing words to complete the following paragraphs about transistorized and capacitive discharge ignitions.

    a. Transistorized ignitions include an **amplifier** in the circuit between the **points** and the **ignition** **coil**. Transistors allow very low voltage through the **points** and the **battery**.

    b. The capacitive discharge system contains a special **distributor**, **amplifier**, and **coil**. When signaled by the distributor, the system operates to charge a **capacitor** to a high voltage which is then discharged through the primary windings in the coil.

13. What is the difference between the electronic ignition system and the conventional ignition system?

    The electronic ignition system contains a magnetic pickup that functions as the ignition points in the conventional system.

14. Select from the following list advantages of the electronic ignition system. Write an "X" in the blank before each correct statement.

    X a. Has no moving parts in the primary circuit

    ___ b. Provides a variable dwell at different engine speeds and operating conditions

    X c. Extends the efficient life of the spark plugs

    X d. Requires little maintenance during life of vehicle

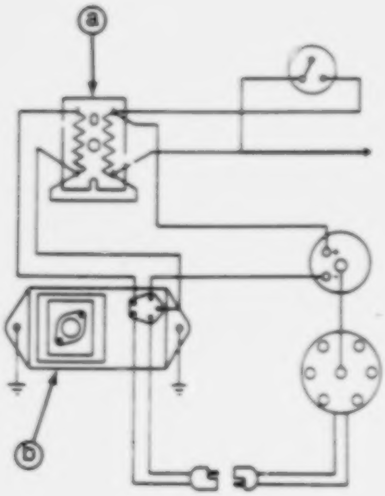
15. Identify the major components of the electronic ignition system shown below. Write the names of the components in the corresponding blanks.

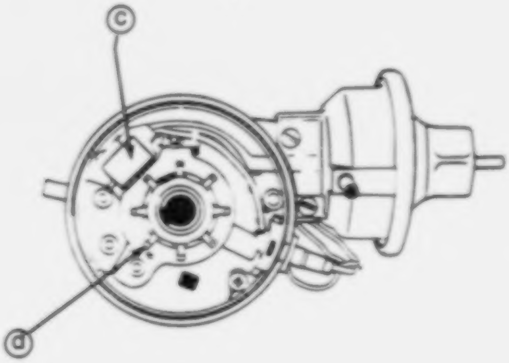
a. **Resistor unit**

b. **Control unit**

c. **Magnetic pickup assembly**

d. **Armature**





16. Explain the functions of the electronic ignition components listed below.

a. Resistance unit--**Maintains constant primary current regardless of engine speed**

b. Magnetic pickup assembly--**Sends a small voltage pulse to control unit that signals switching transistor to stop current flow in primary coil windings**

c. Armature--**Rotates with distributor shaft to produce a voltage pulse in the magnetic pickup**

d. Control unit--**Controls flow of current in primary windings of the ignition coil; maintains dwell**

17. Arrange in order steps in the operation of the electronic ignition system. Write a "1" before the first step, a "2" before the second step, and so on.

2 a. Voltage builds in magnetic pickup circuit as the armature tooth approaches the magnetic pickup

3 b. Voltage in magnetic pickup signals the switching transistor to shut off current flow in the primary circuit

1 c. Primary circuit current flows from the ignition switch, to the resistance unit, through the primary coil windings, through the control unit, and to ground while the ignition switch is on and the armature tooth is not aligned with the magnetic pickup

4 d. Magnetic field in the coil collapses and induces a high voltage surge in the secondary circuit while the primary circuit is open

18. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I
___ II
___ III
___ IV
___ V
___ VI
___ VII
___ VIII
___ IX
___ X
___ XI
___ XII
___ XIII
___ XIV
___ XV
___ XVI
___ XVII

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION B--ELECTRICAL SYSTEMS
UNIT IV--IGNITION SYSTEM

LAP ASSIGNMENT SHEET #1

NAME ______________________ SCORE ______________

1. Match the following terms and definitions. Write the correct numbers in the blanks.

4 a. Ignition bypass circuit
3 b. Dwell
2 c. Electronic ignition system
6 d. Timing
1 e. Primary ignition circuit
5 f. Secondary ignition circuit

1. Low voltage circuit that energizes ignition coil

2. System that uses a control unit and magnetic pickup to control opening and closing of primary circuit

3. Number of degrees of distributor cam rotation that ignition points are closed

4. Auxiliary primary ignition circuit; bypasses resistance unit for full battery voltage to the ignition system during starting

5. High-voltage circuit that produces current to jump spark plug gap

6. Ignition of the fuel-air mixture at the exact moment for maximum power

2. Explain the purpose of the ignition system.

To provide a high-voltage spark to ignite the fuel-air mixture in the combustion chamber.

LAP ASSIGNMENT SHEET #1

3. Identify the parts of the ignition system shown below. Write the correct letters in the blanks before the names of the parts.

_o_ Key switch

_c_ Points

_h_ Rotor

_k_ Battery

_m_ Primary resistor

_e_ Spark plug

_j_ Coil

_b_ Condenser

_a_ Spark advance

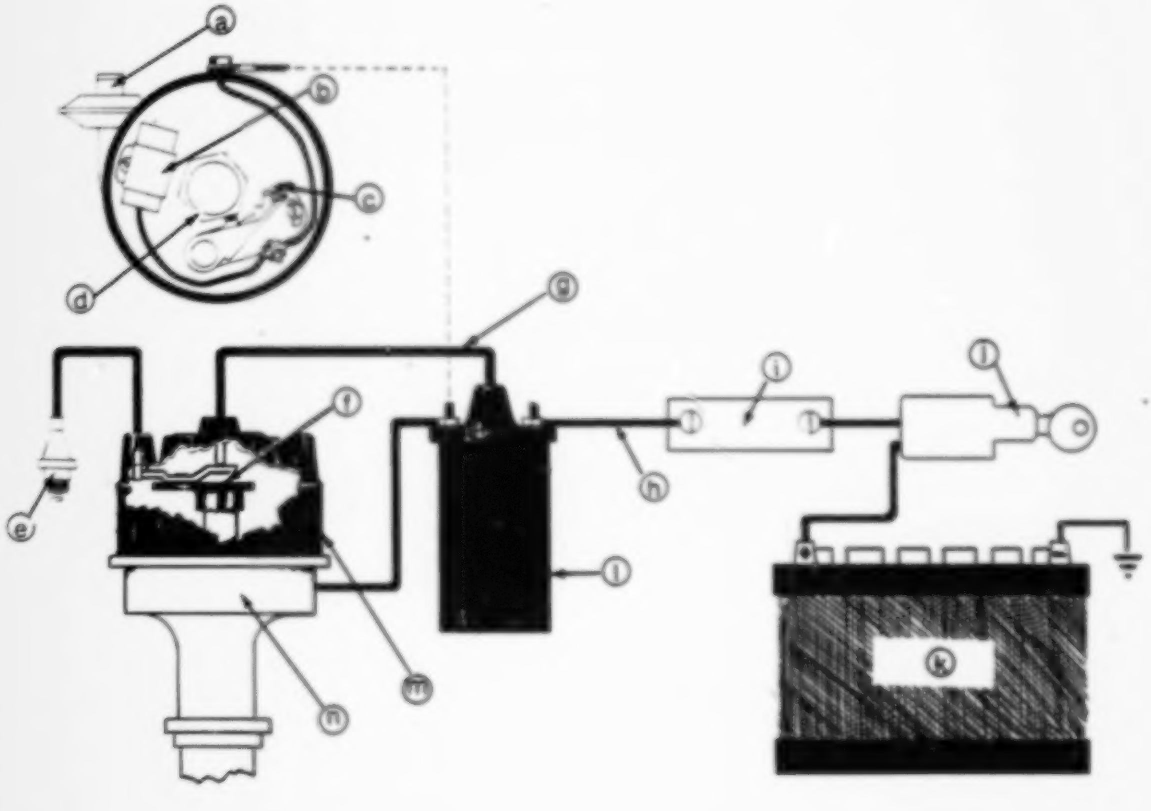
_f_ Distributor

_g_ Distributor cap

_n_ Primary ignition wire

_i_ Secondary ignition cable

_d_ Distributor cam



LAP ASSIGNMENT SHEET #1

4. Match the ignition system components and their functions. Write the correct numbers in the blanks.

_1_ a. Secondary ignition cable

_5_ b. Rotor

_14_ c. Battery

_11_ d. Breaker cam

_10_ e. Condenser

_13_ f. Ignition coil

_8_ g. Spark advance mechanism

_2_ h. Primary ignition wire

_7_ i. Distributor

_3_ j. Spark plug

_9_ k. Resistance unit

_12_ l. Ignition switch

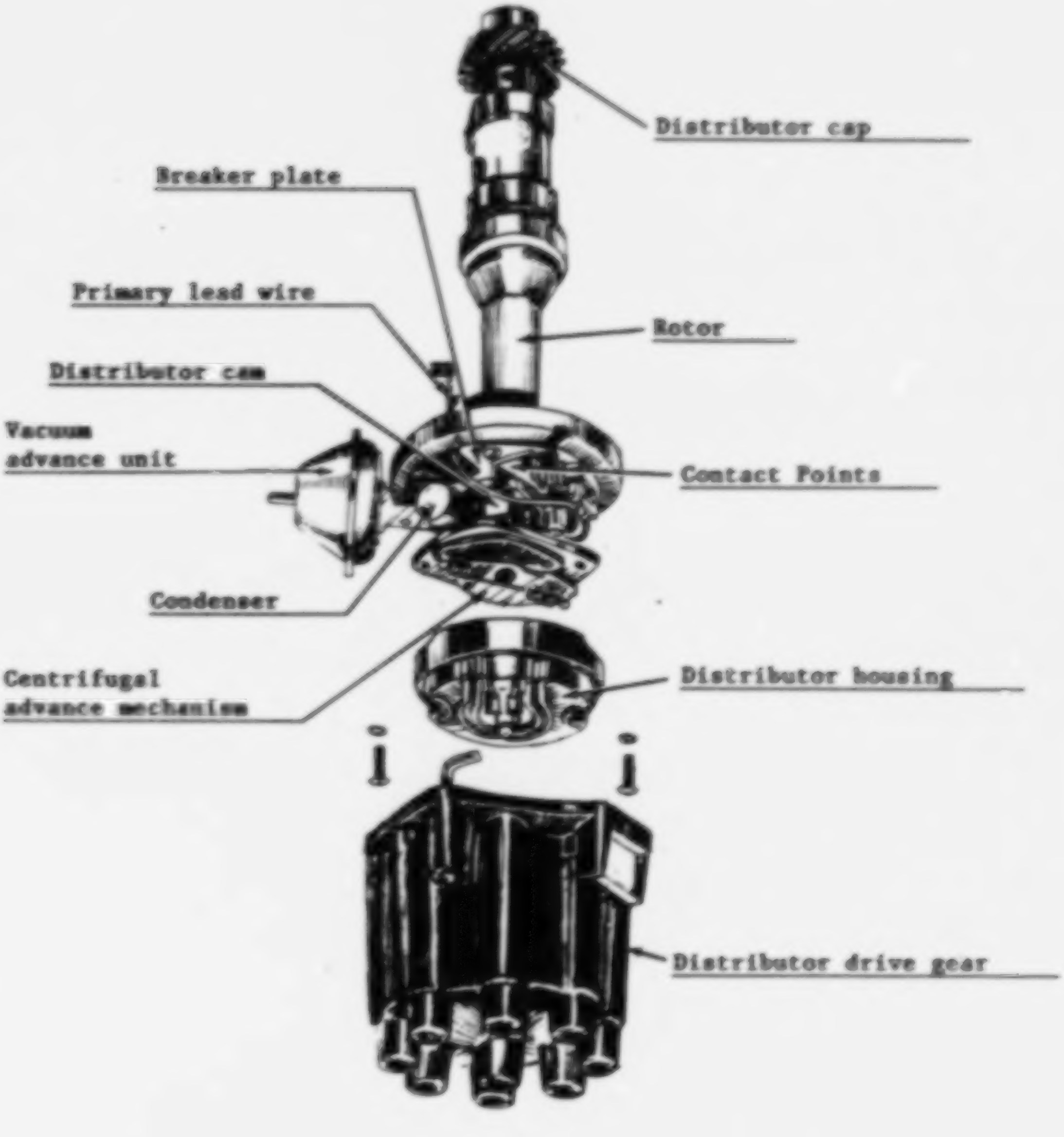
_4_ m. Distributor cap

_6_ n. Breaker points

1. Carries high voltage from coil to spark plug
2. Carries low voltage from battery to primary windings of ignition coil
3. Provides the spark to ignite the fuel-air mixture in the cylinder
4. Weatherproof cap that holds coil and spark plug wires in sequence
5. Directs voltage from the coil to the correct cylinder
6. Opens and closes primary circuit to allow coil to produce high voltage at the spark plugs
7. Contains contact points and condenser; routes high-voltage current from the coil to the proper cylinder
8. Regulates timing of high-voltage circuit for best ignition at all engine speeds and loads
9. Reduces voltage in primary circuit to protect the points
10. Stores extra current; prevents arcing as contact points open
11. Opens and closes contact points
12. Opens and closes primary circuit between battery and coil
13. Transforms voltage needed to jump the spark plug gap
14. Source of electrical power

LAP ASSIGNMENT SHEET #1

5. Identify the parts of the distributor illustrated below. Write the correct names of the parts in the blanks.



107

LAP ASSIGNMENT SHEET #1

6. List the components of primary and secondary ignition system circuits.

PRIMARY

a. Battery

b. Ignition switch

c. Resistance unit

d. Primary coil winding

e. Contact points

f. Condenser

g. Low-voltage wire

SECONDARY

a. Secondary coil winding

b. Distributor cap

c. Rotor

d. Spark plug

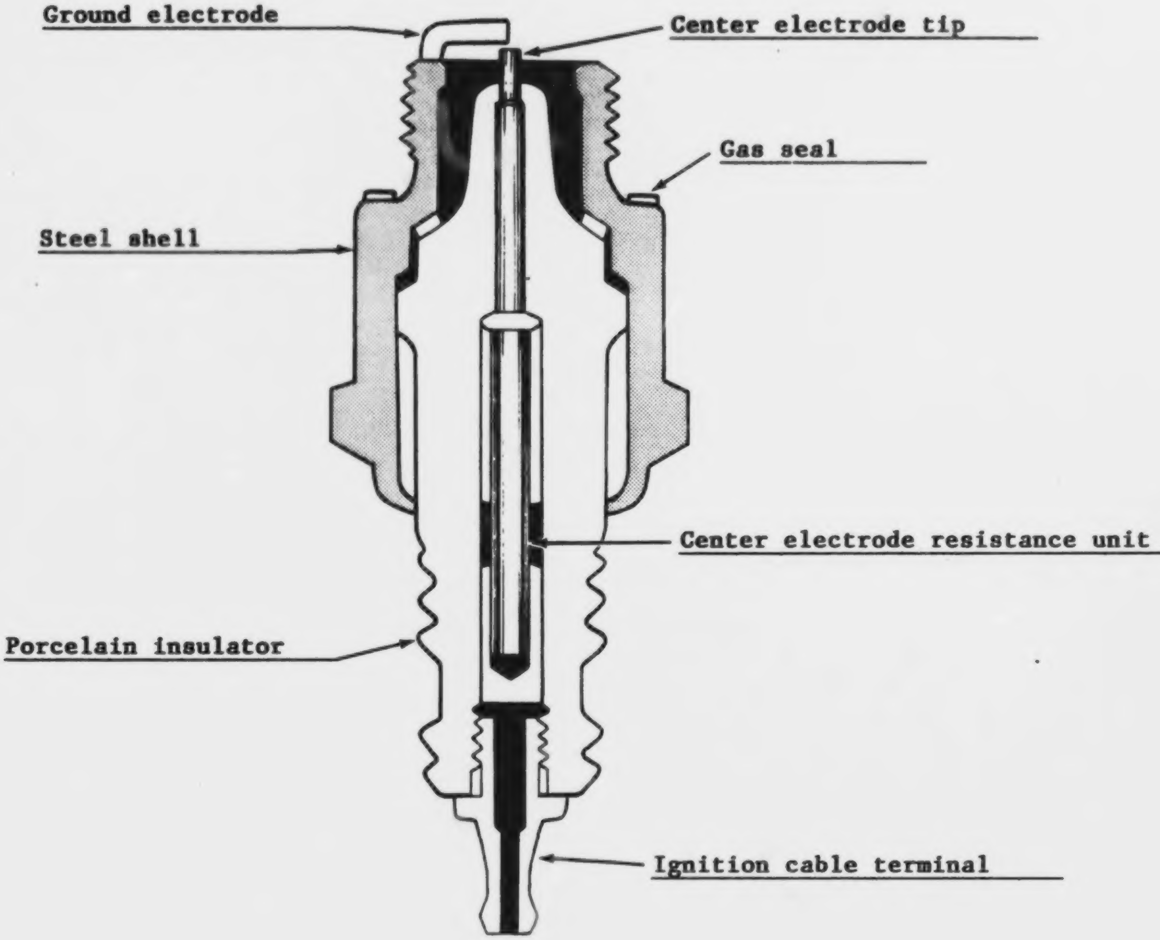
e. High-voltage cable

7. Describe the operation of the ignition system.

Low voltage current flows from battery, through primary coil winding, through contact points, and to ground while the ignition switch is on and contact points are closed. Magnetic field buildup is caused by flow of low-voltage current through primary coil windings. Current flows across point surfaces as contact points open and is then absorbed by the condenser. A high-voltage surge is caused when current flow is stopped and the magnetic field of the primary coil windings collapses across the secondary coil windings. The high-voltage surge is directed from the secondary coil windings, through the distributor cap and rotor, on the spark plug, and to ground.

LAP ASSIGNMENT SHEET #1

8. Identify the parts of the spark plug shown below. Write the correct names of the parts in the blanks.



Ground electrode

Center electrode tip

Gas seal

Steel shell

Center electrode resistance unit

Porcelain insulator

Ignition cable terminal

9. What determines the heat range of a spark plug?

The shape of the plug and the distance that heat must travel from the center electrode to reach the cylinder head.

LAP ASSIGNMENT SHEET #1

10. Match spark plug conditions and illustrations. Write the correct letters in the blanks.

f Splashed deposits

g Oil deposits

b Normal

e Too hot

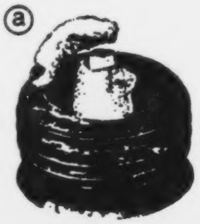
d Preignition

c Carbon deposits

a Modifier deposits

h High-speed glazing

ⓐ



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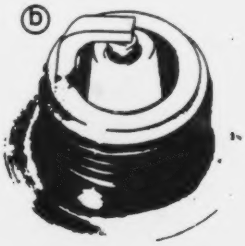

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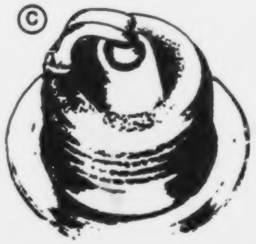

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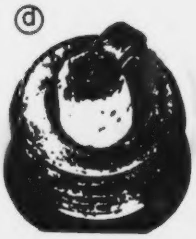

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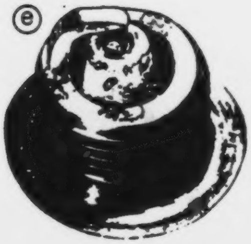

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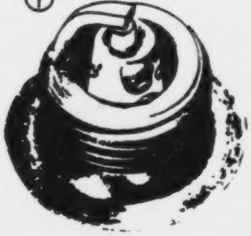

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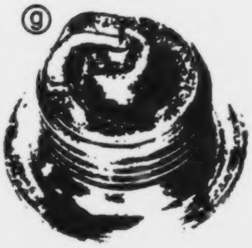

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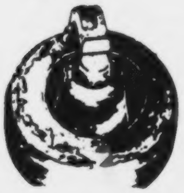


11. Name the two types of secondary ignition cables.

a. **Radio suppression**

b. **Stranded wire**

12. Fill in the missing words in the statement below.

Transistorized and capacitive discharge ignition systems are both designed to increase **primary** voltage to the **coil** and to reduce voltage to the **points**.

LAP ASSIGNMENT SHEET #1

13. Describe the relationship of an electronic ignition system to a conventional ignition system.

Both systems serve the same function. The electronic ignition system uses an electronic control unit and a magnetic pickup instead of the ignition points used in the conventional ignition system.

14. Fill in the missing words to complete the following statements about advantages of the electronic ignition system.

a. Requires little maintenance during the life of the **vehicle**.

b. Has no moving parts in the **primary** **circuit**.

c. Maintains a **constant** **dwell** at all engine speeds and operating conditions.

d. Extends the efficient life of the **spark** **plugs**.

15. Identify the major components of the electronic ignition system illustrated below. Write the correct letters in the blanks.

a Armature

e Ignition coil

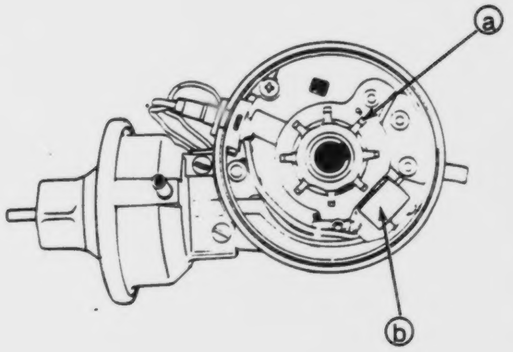
c Resistor unit

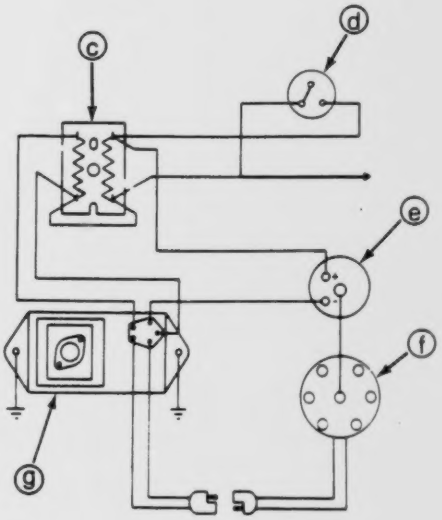
g Control unit

b Magnetic pickup assembly

f Distributor

d Ignition switch





LAP ASSIGNMENT SHEET #1

16. Match major components of the electronic ignition system and their functions. Write the correct numbers in the blanks.

3	a.	Armature	1.	Maintains constant primary current
4	b.	Control unit	2.	Sends voltage pulse to switch primary circuit
2	c.	Magnetic pickup assembly	3.	Rotates with the distributor shaft
1	d.	Resistance unit	4.	Controls flow of current through primary side of the coil

17. Describe the operation of the electronic ignition system through one complete cycle.

Primary circuit current flows from the ignition switch to the resistance unit, through the primary coil windings, through the control unit, and to ground while the ignition switch is on and the armature tooth is not aligned with the magnetic pickup. Voltage builds in magnetic pickup circuit as the armature tooth approaches the magnetic pickup. Voltage in magnetic pickup signals the switching transistor to shut off current flow in the primary circuit. Magnetic field in the coil collapses and induces a high voltage surge in the secondary circuit while the primary circuit is open.

18. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I
____ II
____ III
____ IV
____ V
____ VI
____ VII
____ VIII
____ IX
____ X
____ XI
____ XII
____ XIII
____ XIV
____ XV
____ XVI
____ XVII

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION B--ELECTRICAL SYSTEMS
UNIT IV--IGNITION SYSTEM

LAP ASSIGNMENT SHEET #2

NAME________________________ SCORE______________

1. Define the following terms.

   a. Dwell-- **Number of degrees of distributor cam rotation that ignition points are closed**

   b. Electronic ignition system-- **System that uses a control unit and a magnetic pickup to control opening and closing of the primary circuit**

   c. Ignition bypass circuit-- **Auxiliary primary ignition circuit; bypasses resistance unit for full battery voltage to the ignition system during starting**

   d. Primary ignition circuit-- **Low-voltage circuit that energizes ignition coil**

   e. Secondary ignition circuit-- **High-voltage circuit that produces current to jump spark plug gap**

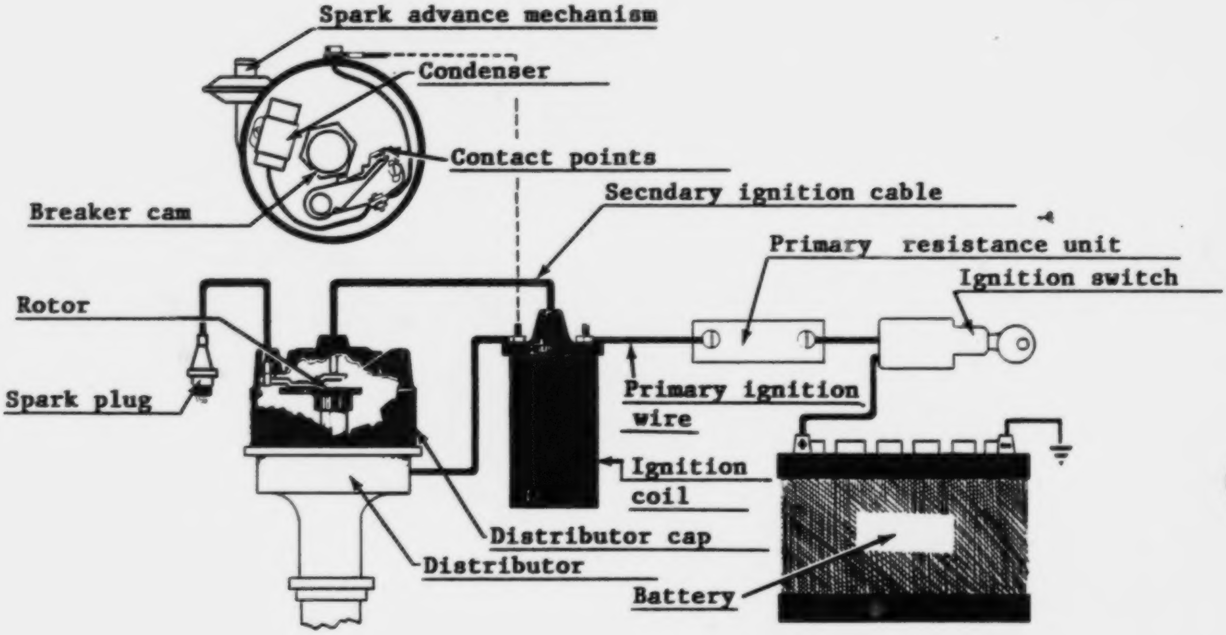
   f. Timing-- **Ignition of the fuel-air mixture at the exact moment for maximum power**

2. Fill in the missing word in the statement below.

   The purpose of the ignition system is to provide a high-voltage **spark** to ignite the fuel-air mixture.

LAP ASSIGNMENT SHEET #2

3. Identify the components of the ignition system in the illustration below. Write the correct names of the parts in the blanks.



4. Explain the functions of the following ignition system components.

a. Battery-- **Source of electrical power**

b. Breaker cam--**Opens and closes contact points**

c. Breaker points-- **Opens and closes primary circuit to allow coil to produce high voltage at the spark plugs**

d. Condenser-- **Stores extra current; prevents arcing as contact points open**

LAP ASSIGNMENT SHEET #2

e. Distributor-- **Contains contact points and condenser; routes high-voltage current from the coil to the proper cylinder**

f. Distributor cap-- **Weatherproof cap that holds coil and spark plug wires in sequence**

g. Ignition coil-- **Transforms voltage needed to jump the spark plug gap**

h. Ignition switch-- **Opens and closes circuit between battery and coil**

i. Primary ignition wire-- **Carries low voltage from battery to primary windings of ignition coil**

j. Resistance unit-- **Reduces voltage in primary circuit to protect the points**

k. Secondary ignition cable-- **Carries high voltage from coil to spark plugs**

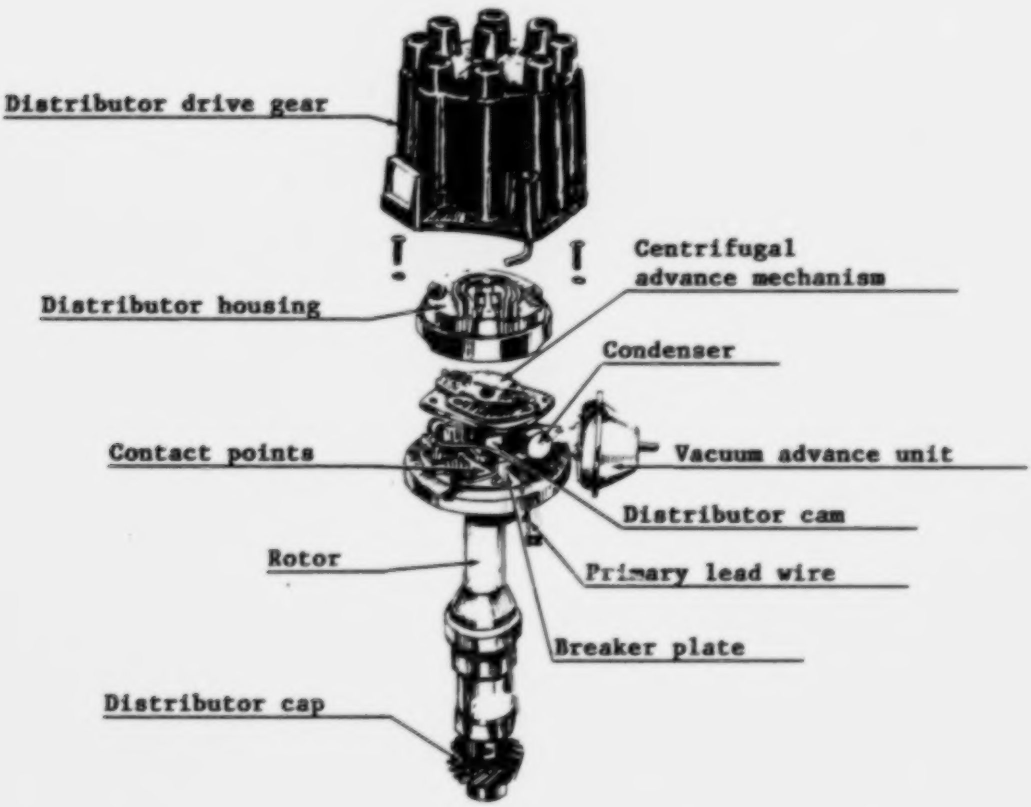
l. Rotor-- **Directs voltage from the coil to the correct cylinder**

m. Spark advance mechanism-- **Regulates timing of high-voltage circuit for best ignition at all engine speeds and loads**

n. Spark plugs-- **Provides the spark to ignite the fuel-air mixture**

LAP ASSIGNMENT SHEET #2

5. Identify the components of the distributor in the illustration below. Write the names of the components in the correct blanks.



6. List the components of primary and secondary ignition system circuits.

PRIMARY

a. **Battery**
b. **Ignition switch**
c. **Resistance unit**
d. **Primary winding of the coil**
e. **Contact points**
f. **Condenser**
g. **Low-voltage wire**

LAP ASSIGNMENT SHEET #2

SECONDARY

a. Secondary winding of the coil

b. Distributor cap

c. Rotor

d. Spark plugs

e. High-voltage cable

7. Describe the operation of the ignition system.

Low-voltage current flows from battery, through primary coil winding, through contact points, and to ground while the ignition switch is on and contact points are closed. Magnetic field buildup is caused by flow of low-voltage current through primary coil windings. Current flows across point surfaces as contact points open and is then absorbed by the condenser. A high-voltage surge is caused when current flow is stopped and the magnetic field of the primary coil windings collapses across the secondary coil windings. The high-voltage surge is directed from the secondary coil windings, through the distributor cap and rotor, on to the spark plug, and to the ground.

LAP ASSIGNMENT SHEET #2

8. Identify the parts of a spark plug. Write the correct letters in the blanks.

g Center electrode tip

c Ground electrode

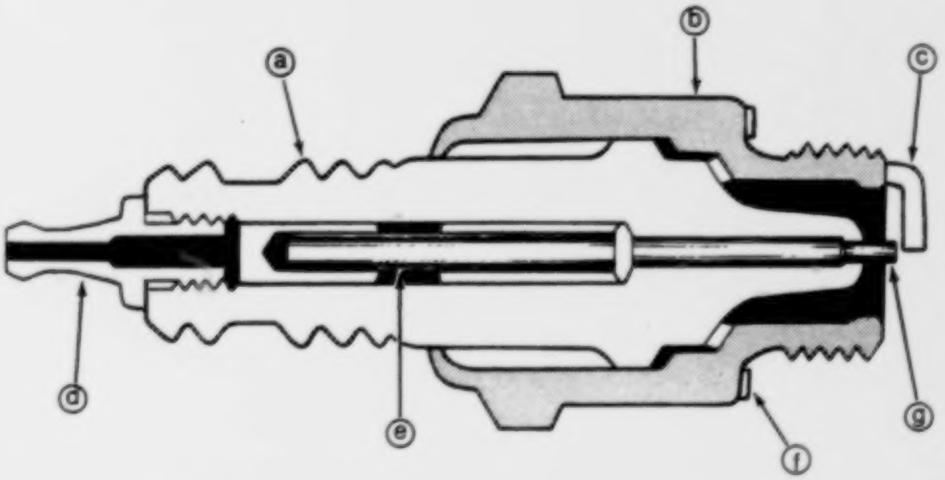
a Porcelain insulator

b Steel shell

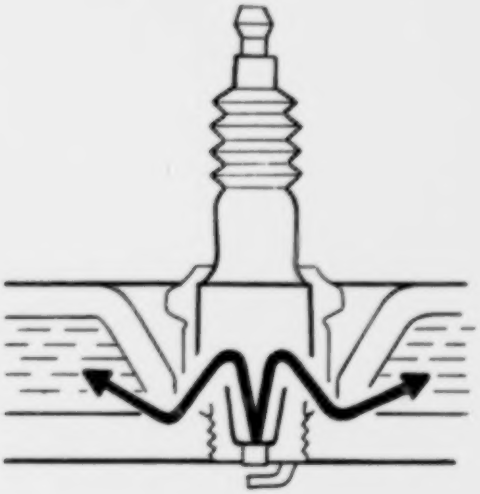
d Ignition cable terminal

e Center electrode resistance unit

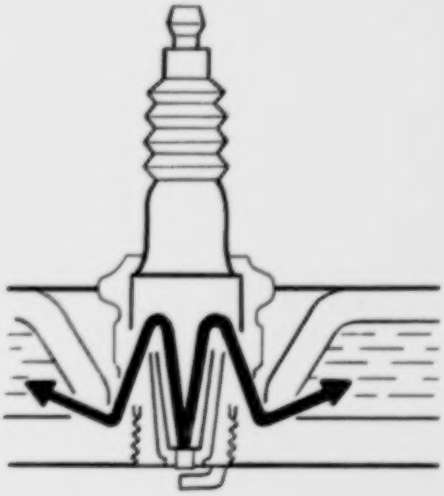
f Gas seal



9. Identify the cold spark plug in the illustration below. Write "cold" in the blank below the correct illustration.



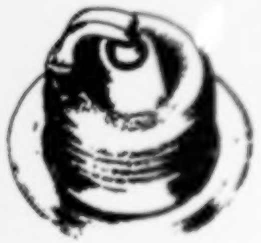
a. cold



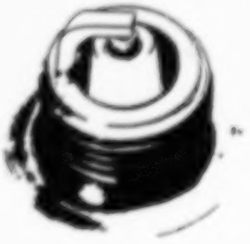
b. ____________________

LAP ASSIGNMENT SHEET #2

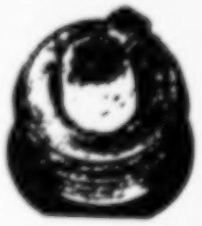
10. Identify the spark plug conditions shown below. Write the conditions in the blanks below the drawings.



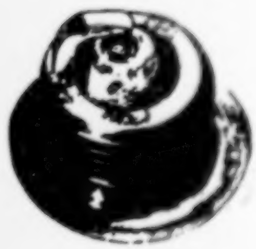
a. **Carbon deposits**



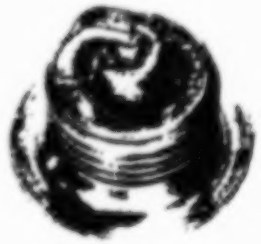
b. **Normal**



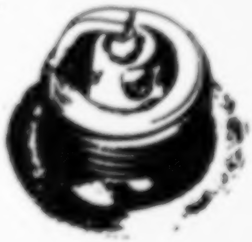
c. **Preignition**



d. **Too hot**



e. **Oil deposits**



f. **Splash deposits**

11. What are the two types of secondary ignition cables?

Radio suppression and stranded wire

12. Fill in the missing words to complete the following statement about transistorized and capacitive discharge ignitions.

While transistorized and capacitive discharge ignition systems both increase primary voltage to the **coil** and reduce voltage to the **points**, the **capacative discharge** system requires a special distributor, amplifier, and coil.

LAP ASSIGNMENT SHEET #2

13. Fill in the missing words to complete the following statement about the relationship of the electronic ignition system to the conventional ignition system.

In the electronic ignition system, an electronic **control** **unit** and a **magnetic** **pickup** function as the **ignition** **points** in the conventional ignition system.

14. List the main advantages of an electronic ignition system.

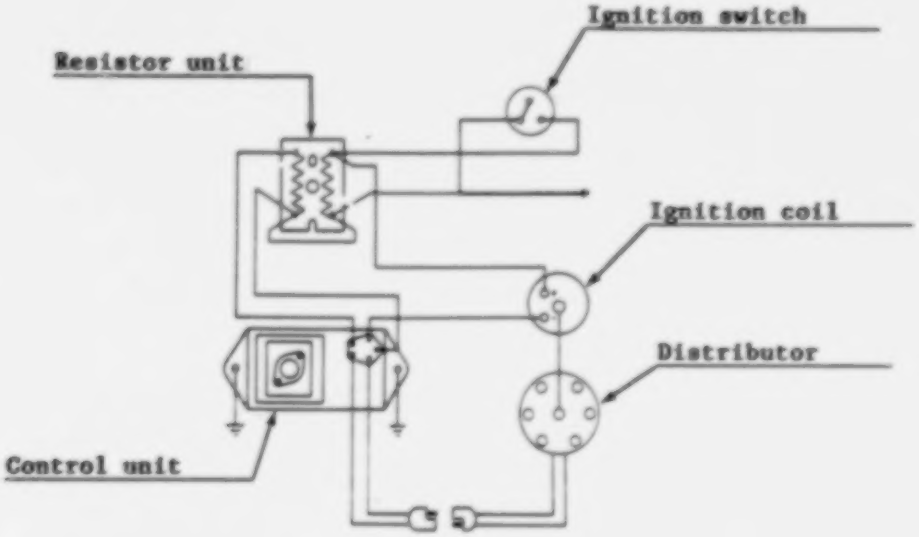
   a. **Requires little maintenance during the life of the vehicle**

   b. **Has no moving parts in the primary circuit**

   c. **Maintains a constant dwell at all engine speeds and operating conditions**

   d. **Extends the efficient life of the vehicle**

15. Identify major components of the electronic ignition system. Write the correct names of the components in the blanks.



LAP ASSIGNMENT SHEET #2

16. Describe the functions of the following electronic ignition system components.

    a. Armature (reluctor)--**Rotates with the distributor shaft; produces a voltage pulse in the magnetic pickup**

    b. Control unit--**Controls current flow in the primary windings of the ignition coil and maintains dwell**

    c. Magnetic pickup assembly--**Sends a small voltage pulse to the control unit to trigger switching transistor to stop current flow in the primary coil winding**

    d. Resistance unit--**Maintains constant primary current with variations in engine speed**

17. Describe the operation of the electronic ignition system.

    Primary circuit current flows from the ignition switch to the resistance unit, through the primary coil windings, through the control unit, and to ground while the ignition switch is on and the armature tooth is not aligned with the magnetic pickup. Voltage builds in the magnetic pickup circuit as the armature tooth approaches the magnetic pickup. Voltage in the magnetic pickup signals the switching transistor to shut off current flow in the primary circuit. Magnetic field in the coil collapses and induces a high-voltage surge in the secondary circuit while the primary circuit is open.

18. Stop. Have your instructor evaluate your assignment sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

State Department of Vocational and Technical Education
CIMC
Stillwater, Oklahoma

LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. ______ CODE ______

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT V--CHARGING SYSTEM

LEARNING ACTIVITY PACKET NO. 13

PREREQUISITE LAP(S) 9, 10

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Charging System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify the components of the charging system. The student will also be able to remove, replace, disassemble, and reassemble a generator and an alternator.

TASKS INCLUDED IN THIS LAP:

1. Remove and replace a generator.
2. Disassemble, check, and reassemble a generator.
3. Remove and replace an alternator.
4. Disassemble, check, and reassemble an alternator.
5. Test charging circuit resistance of an alternator.
6. Test current output of an alternator.
7. Test external type voltage regulator.
8. Test internal type voltage regulator on vehicle.

SECTION B--ELECTRICAL SYSTEMS
UNIT V--CHARGING SYSTEM

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read Unit and Specific Objectives, page AM II-249-B.

_____ 2. Complete Charging System Pretest, LAP page 13.

_____ 3. Study The sections of the Information Sheet, pages AM II-253-B through 256-B, indicated by your instructor on your pretest. Be sure to study the transparency masters when required.

_____ 4. Refer To Step 13 of the Pretest. If additional study is required, continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do LAP Assignment Sheet #1, LAP page 21.

_____ 6. Do LAP Assignment Sheet #2, LAP page 29.

_____ 7. Check The following tasks which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Remove and replace a generator. (10)	__________	__________
_____b.	Disassemble, check, and reassemble a generator. (16)	__________	__________

LEARNING STEPS

		Instructor Initials/Date	
Student Check		Skilled	Moderately Skilled
____c.	Remove and replace an alternator. (22)	____	____
____d.	Disassemble, check, and reassemble an alternator. (28)	____	____
____e.	Test charging circuit resistance of an alternator. (34)	____	____
____f.	Test current output of an alternator. (40)	____	____
____g.	Test external type voltage regulator. (46)	____	____
____h.	Test internal type voltage regulator on vehicle. (52)	____	____

____ 8. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed by your instructor, proceed to Learning Step 59. Otherwise, continue to Learning Step 9.

____ 9. Refer — To Learning Step 7a. If this task has been initialed by your instructor, proceed to Learning Step 15. Otherwise, continue to Learning Step 10.

____10. Study — Job Sheet #1--Remove and Replace a Generator, pages AM II-269-B through AM II-271-B.

____11. Watch — Slide/tape presentation, "Remove and Replace a Generator" (B-V-1).

LEARNING STEPS

____12. Do Job Sheet #1--Remove and Replace a Generator.

____13. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and then proceed to Learning Step 15. Otherwise, repeat Learning Steps 10 through 12 and continue to Learning Step 14.

____14. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and then continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 15.

____15. Refer To Learning Step 7b. If this task has been initialed by your instructor, proceed to Learning Step 21. Otherwise, continue to Learning Step 16.

____16. Study Job Sheet #2--Disassemble, Check, and Reassemble a Generator, pages AM II-273-B through AM II-279-B.

____17. Watch Slide/tape presentation, "Disassemble, Check and Reassemble a Generator" (B-V-2).

____18. Do Job Sheet #2--Disassemble, Check, and Reassemble a Generator.

____19. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and then proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and continue to Learning Step 20.

LEARNING STEPS

_____20. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and then continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and continue to Learning Step 21.

_____21. Refer To Learning Step 7c. If this task has been initialed by your instructor, proceed to Learning Step 27. Otherwise continue to Learning Step 22.

_____22. Study Job Sheet #3--Remove and Replace an Alternator, pages AM II-281-B through AM II-283-B.

_____23. Watch Slide/tape presentation, "Remove and Replace an Alternator" (B-V-3).

_____24. Do Job Sheet #3--Remove and Replace an Alternator.

_____25. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and then proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and continue to Learning Step 26.

_____26. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating have your instructor initial Learning Step 7c and then continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7c and continue to Learning Step 27.

LEARNING STEPS

_____27. Refer To Learning Step 7d. If this task has been initialed by your instructor, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.

_____28. Study Job Sheet #4--Disassemble, Check, and Reassemble an Alternator, pages AM II-285-B through AM II-291-B.

_____29. Watch Slide/tape presentation, "Disassemble, Check, and Reassemble an Alternator" (B-V-4).

____30. Do Job Sheet #4--Disassemble, Check, and Reassemble an Alternator.

____31. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and proceed to Learning Step 33. Otherwise, repeat Learning Steps 28 through 30 and continue to Learning Step 32.

_____32. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and then continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7d and then continue to Learning Step 33.

_____33. Refer To Learning Step 7e. If this task has been initialed by your instructor, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.

____34. Study Job Sheet #5--Test Charging Circuit Resistance of an Alternator, pages AM II-293-B through AM II-295-B.

LEARNING STEPS

_____35.	Watch	Slide/tape presentation, "Test Charging Circuit Resistance of an Alternator" (B-V-5).
_____36.	Do	Job Sheet #5--Test Charging Circuit Resistance of an Alternator.
_____37.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and proceed to Learning Step 39.
_____38.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and then continue to Learning Step 39. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7e and continue to Learning Step 39.
_____39.	Refer	To Learning Step 7f. If this task has been initialed by your instructor, proceed to Learning Step 45. Otherwise, continue to Learning Step 40.
_____40.	Study	Job Sheet #6--Test Current Output of an Alternator, pages AM II-297-B through AM II-299-B.
_____41.	Watch	Slide/tape presentation, "Test Current Output of an Alternator" (B-V-6).
_____42.	Do	Job Sheet #6--Test Current Output of an Alternator.

LEARNING STEPS

_____43. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and proceed to Learning Step 45. Otherwise, repeat Learning Steps 40 through 42 and continue to Learning Step 44.

_____44. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7f and then continue to Learning Step 45. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7f and continue to Learning Step 45.

_____45. Refer To Learning Step 7g. If this task has been initialed by your instructor, proceed to Learning Step 51. Otherwise, continue to Learning Step 46.

_____46. Study Job Sheet #7--Test External Type Voltage Regulator, pages AM II-301-B and 302-B.

_____47. Watch Slide/tape presentation, "Test External Type Voltage Regulator" (B-V-7).

_____48. Do Job Sheet #7--Test External Type Voltage Regulator.

_____49. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7g and proceed to Learning Step 51. Otherwise, repeat Learning Stpes 46 through 48 and continue to Learning Step 50.

LEARNING STEPS

_____50. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7g and then continue to Learning Step 51. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7g and continue to Learning Step 51.

_____51. Refer To Learning Step 7h. If this task has been initialed by your instructor, proceed to Learning Step 57. Otherwise, continue to Learning Step 52.

_____52. Study Job Sheet #8--Test Internal Type Voltage Regulator on Vehicle, pages AM II-303-B through AM II-305-B.

_____53. Watch Slide/tape presentation, "Test Internal Type Voltage Regulator on Vehicle" (B-V-8).

_____54. Do Job Sheet #8--Test Internal Type Voltage Regulator on Vehicle.

_____55. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7h and then proceed to Learning Step 57. Otherwise, repeat Learning Steps 52 through 54 and continue to Learning Step 56.

_____56. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7h and then continue to Learning Step 57. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7h and continue to Learning Step 57.

LEARNING STEPS

_____57. Refer To Learning Step 7. If all tasks have been initialed by your instructor, continue to Learning Step 58. Otherwise, refer to the Learning Step indicated in parentheses after the unsigned task.

_____58. Review Information Sheet (pages AM II-253-B through 256-B) and LAP Assignment Sheets.

_____59. Take Charging System Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION B--ELECTRICAL SYSTEMS
UNIT V--CHARGING SYSTEM

PRETEST

NAME ______________________ SCORE ______________

DIRECTIONS: The purpose of this pretest is to determine how much you already know about the charging system. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing might keep you from receiving needed instruction.

1. What are the two primary functions of the charging system?

   a. **To recharge the battery**

   b. **To maintain electrical current to meet the needs of the vehicle**

2. Define the following terms.

   a. Ampere--**Unit of measure indicating rate of current flow**

   b. Volt--**Unit of measure indicating electrical pressure or force**

   c. Ohm--**Unit of measure indicating resistance to flow of electrical current**

   d. Diode--**Electrical device that allows electrical current flow in only one direction**

   e. Short circuit--**Electrical connection that provides a shorter path for current flow**

   f. Open circuit--**Incomplete circuit caused by a broken wire or disconnection**

   g. Grounded circuit--**Circuit where wire touches ground causing current to flow to ground instead of through circuit**

   h. Rectifier--**Group of diodes that convert alternating current to direct current**

i. Phase--Stator winding with a positive diode and a negative diode

j. Rated output--Maximum D.C. amperage output from an alternator

3. Explain the functions of the following charging system components.

a. Battery--Supplies electrical power to starter and operates electrical system during periods of low charging system output

b. Ammeter--Measures the rate of current flow

c. Regulator--Controls generator voltage and current output

d. Generator or alternator--Supplies electricity to battery and the electrical system when driven by the engine

e. Indicator light--Indicates a "no charge" condition in the charging system

PRETEST

4. Identify the parts of the generator shown below. Write the names of the parts in the corresponding blanks.

a. **Field coils**

b. **Generator housing**

c. **Fan**

d. **Pulley**

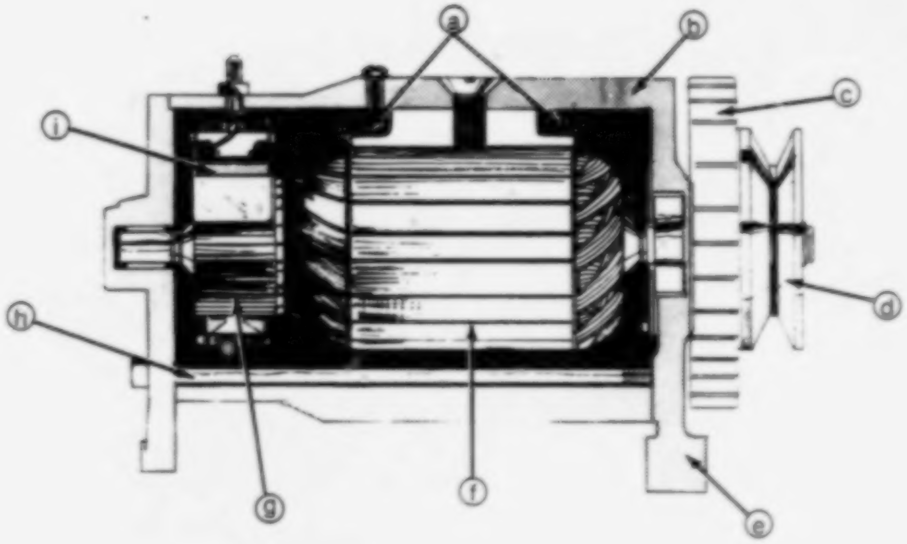
e. **Drive end frame**

f. **Armature**

g. **Commutator**

h. **Through bolt**

i. **Brushes**



5. Identify the parts of the alternator shown below. Write the names of the parts in the corresponding blanks.

   a. **Stator assembly**

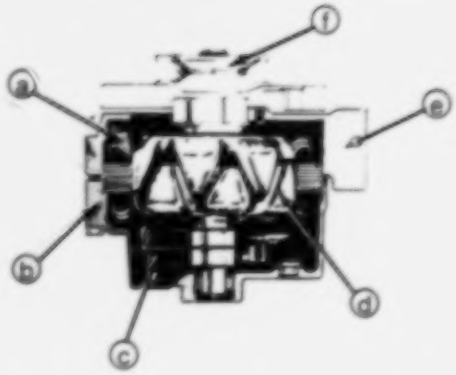
   b. **Slip ring end frame**

   c. **Brush assembly**

   d. **Rotor assembly**

   e. **Drive end frame**

   f. **Pulley**



6. Distinguish between functions of the alternator and the generator. In the blanks before the following statements, write an "A" if it is a function of the alternator or a "G" if it is a function of the generator.

   A a. Rectifies A.C. to D.C. with a series of diodes

   G b. Rectifies current through a segmented commutator and brushes

   G c. Rotates the armature windings inside the field

   A d. Rotates the field inside the stationary windings

7. Fill in the missing words to complete the following statements about advantages of th alternator as compared to the generator.

   a. Produces **higher** output at **low** engine speeds.

   b. Requires **less** **maintenance** because of its **simple** construction.

8. Explain why an alternator produces more current than a generator at low speed.

Alternator uses more pole pieces than a generator; many more magnetic lines of force are cut during a single revolution of the rotor.

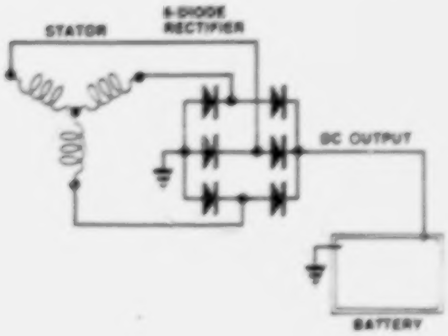
9. Complete the following statements about the construction of an alternator stator.

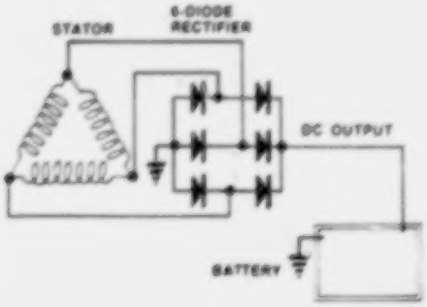
   a. The stator core is constructed of **stamped** **steel** **plates** riveted together to form a **laminated** **core**.

   b. **Three** different coil windings are equally spaced around the **core**.

   c. Stator is electrically connected to the **rectifier** **assembly** containing one positive and one negative **diode** **rectifier** for each **winding**.

10. Identify the two stator windings shown below. Write the names of the windings in the blanks below the drawings.





a. **Wye - connected**

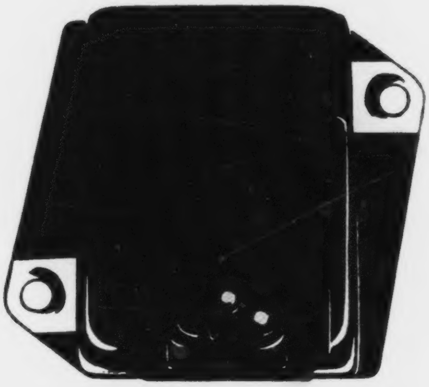
b. **Delta - connected**

11. Complete the following statements to explain how current and voltage are regulated in an alternator.

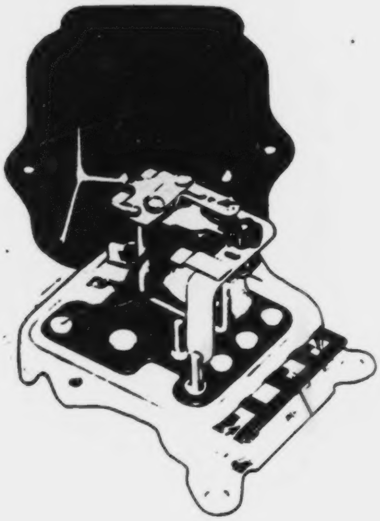
    a. Current is regulated by **the number of turns of wire in each phase**

    b. Voltage is regulated by **controlling the current flow in the rotor field**

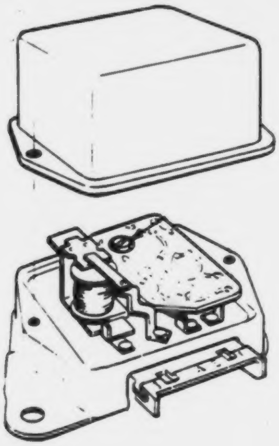
12. Identify the types of voltage regulators shown below. Write the correct names in the blanks below the drawings.



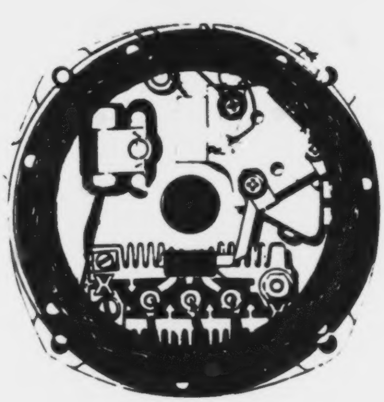
a. **Electronic external**



b. **Electromechanical**



c. **Transistorized**



d. **Electronic internal**

PRETEST

13. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I
_____II
_____III
_____IV
_____V
_____VI
_____VII
_____VIII
_____IX
_____X
_____XI
_____XII

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION B--ELECTRICAL SYSTEMS
UNIT V--CHARGING SYSTEM

LAP ASSIGNMENT SHEET #1

NAME ____________________ SCORE ____________

1. What are the two functions of the charging system?

   a. **To recharge battery**

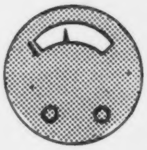
   b. **To supply electrical current to meet operating needs of vehicle**

2. Match the following terms and definitions. Write the correct numbers in the blanks.

4	a.	Converts A.C. to D.C.	1.	Ampere
6	b.	Stator winding with a positive diode and a negative diode	2.	Volt
1	c.	Measure of rate of current flow	3.	Ohm
5	d.	Maximum D.C. amperage of an alternator	4.	Rectifier
2	e.	Measure of electrical pressure	5.	Rated output
9	f.	Circuit with a broken or disconnected wire	6.	Phase
10	g.	Circuit with wire touching the ground	7.	Diode
3	h.	Measure of resistance to electrical flow	8.	Short circuit
8	i.	Circuit with a wire touching another wire	9.	Open circuit
7	j.	Device that allows electrical current to flow in only one direction	10.	Grounded circuit

3. Identify and explain the functions of the following charging system components. Write the name of each component and explain its function in the blanks beside the illustration.

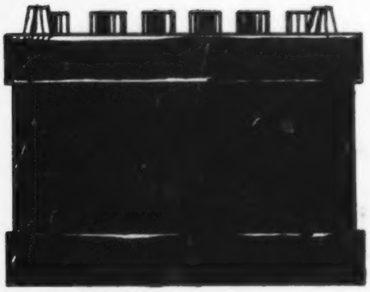
   a.



Ammeter--Measures rate of current flow

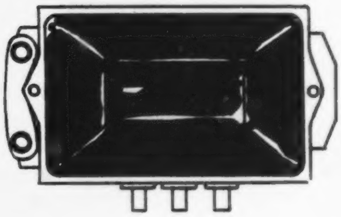
LAP ASSIGNMENT SHEET #1

b.



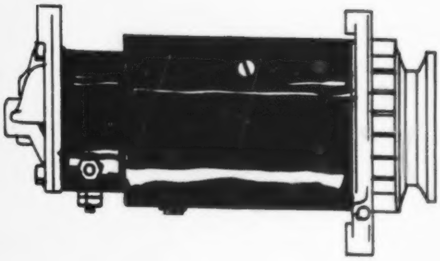
Battery--Source of electrical power for starting and operating under heavy loads or generator speeds

c.



Regulator--Controls generator voltage and current output

d.

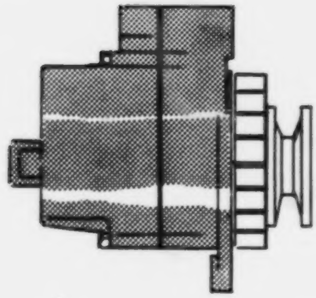


Generator--Supplies electricity to the battery and the electrical system

140

LAP ASSIGNMENT SHEET #1

e.



Alternator--Supplies electrical power to the battery and to the electrical system

4. Match the names of parts of the generator and their locations on the illustration below. Write the correct letters in the blanks.

__b__ Armature

__h__ Brushes

__c__ Commutator

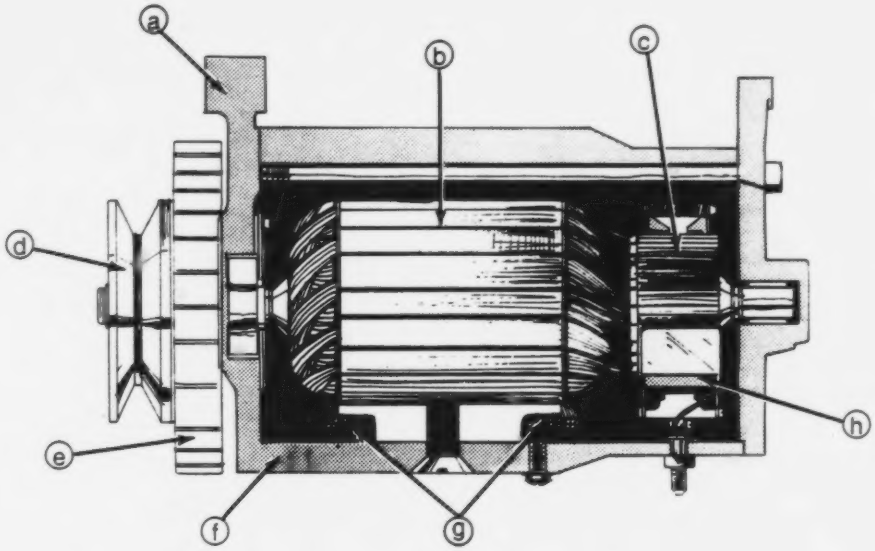
__a__ Drive end frame

__e__ Fan

__g__ Field coils

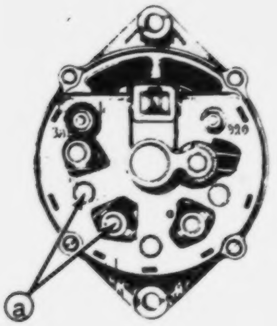
__f__ Generator housing

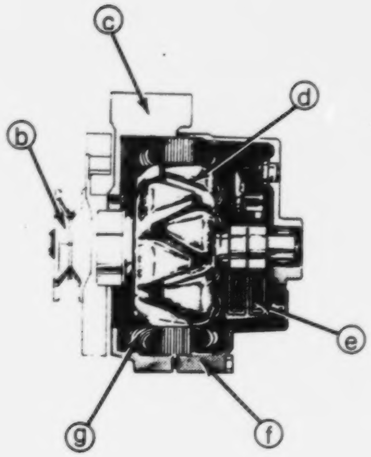
__d__ Pulley



LAP ASSIGNMENT SHEET #1

5. Identify the parts of the alternator in the illustration below. Write the names of the parts in the blanks corresponding to the letters on the illustration.





a. **Diodes**

b. **Pulley**

c. **Drive end frame**

d. **Rotor assembly**

e. **Brush assembly**

f. **Slip ring end frame**

g. **Stator assembly**

LAP ASSIGNMENT SHEET #1

6. Below are listed characteristics of alternators and characteristics of generators. In the blank in front of each characteristic write a "G" if the characteristic applies to a generator or an "A" if the characteristic applies to an alternator.

   G a. Rotates armature windings inside the field

   A b. Rotates field inside stationary windings

   G c. Uses commutator and brushes to rectify current

   A d. Uses diodes to rectify A.C. to D.C.

7. What are the two advantages of an alternator over a generator?

   a. **Produces higher output at slower engine speeds**

   b. **Requires less maintenance because of simple construction**

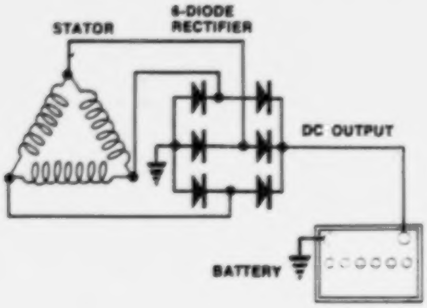
8. How does the alternator produce more current than a generator?

   An alternator has more pole pieces (14) than a generator (2). More pole pieces means more lines of magnetic force are cut during each revolution.

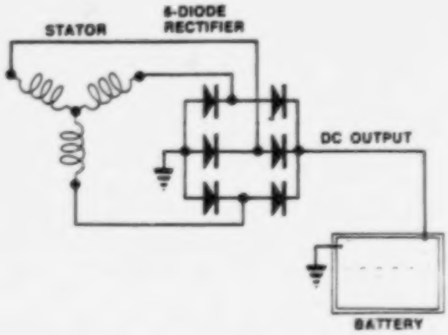
9. Fill in the missing words in the paragraph below.

   The stator is constructed around a central core that is made up of a predetermined number of **stamped** **steel** **plates**, which are **riveted** together to form a **laminated** **core**. Three **coil** **windings** are equally spaced around the core. The stator is electrically connected to the **rectifier** **assembly** which contains one negative and one positive **diode** for each **winding**.

10. Identify the two types of stator windings shown below. Write the correct names in the blanks.



a. **Delta-connected**



b. **Wye-connected**

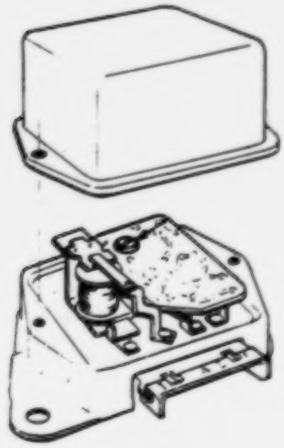
11. Explain how voltage and current are regulated in an alternator.

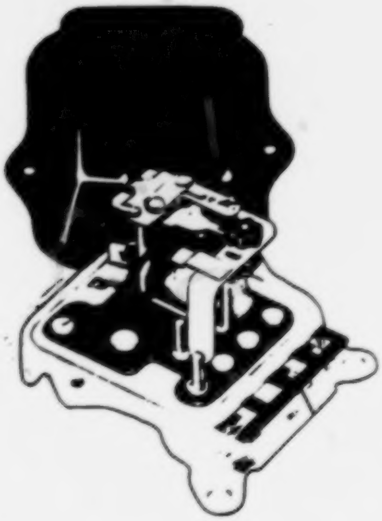
Current capacity is regulated by the number of turns of wire in each phase.

Voltage is regulated by controlling current flow in the rotor field.

144

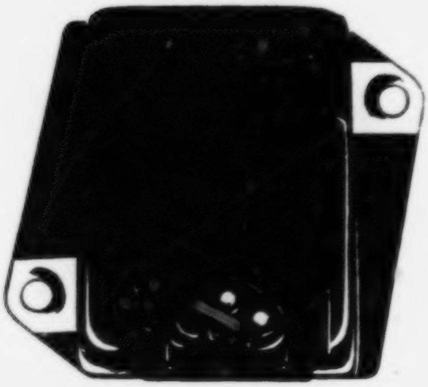
12. Identify the types of voltage regulators shown below. Write the correct names in the blanks.

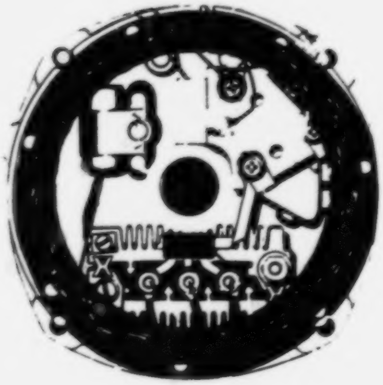




a. **Transistorized**

b. **Electromechanical**





c. **Electronic - external**

d. **Electronic - internal**

LAP ASSIGNMENT SHEET #1

13. Stop. Have your instructor evalute your assignment sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I

_____II

_____III

_____IV

_____V

_____VI

_____VII

_____VIII

_____IX

_____X

_____XI

_____XII

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION B--ELECTRICAL SYSTEMS
UNIT V--CHARGING SYSTEM

LAP ASSIGNMENT SHEET #2

NAME ______________________ SCORE ______________

1. Explain the functions of the charging system.

   To recharge the battery and maintain electrical current to meet the operating needs of the vehicle.

2. Define the following terms.

   a. Ampere--**Measure of electrical current**

   b. Diode--**Electronic device that allows current to flow through it in only one direction**

   c. Grounded circuit--**Circuit with a wire touching ground, allowing current to flow to ground instead of to the circuit**

   d. Open circuit--**Circuit with a broken or disconnected wire**

   e. Ohm--**Measure of electrical resistance**

   f. Phase--**Stator winding with a positive and a negative diode**

   g. Rectifier--**Group of diodes used to convert alternating current to direct current**

   h. Rated output--**Maximum D.C. amperage of an alternator**

i. Short circuit-- **Wire touching another wire, providing a shorter path for current to flow**

j. Volt-- **Measure of electrical pressure**

3. Match charging system components and their functions. Write the correct numbers in the blanks. (A blank may have more than one correct answer.)

4 a. Controls generator voltage and current output

3,5 b. Supplies electrical power to battery and electrical system

2 c. Source of electrical power for starting and for operating the electrical system during low speeds or heavy loads

6 d. Warns of a "no-charge" situation

1 e. Measures rate of current flow

1. Ammeter
2. Battery
3. Alternator
4. Regulator
5. Generator
6. Indicator light

LAP ASSIGNMENT SHEET #2

4. Identify the following charging system components. Write the correct names in the corresponding blanks.

a. **Generator**

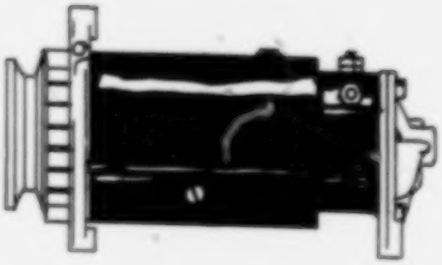
b. **Battery**

c. **Alternator**

d. **Ammeter**

e. **Regulator**

ⓐ



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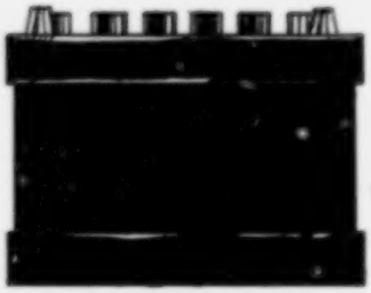

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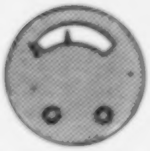

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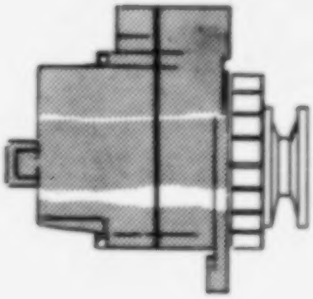

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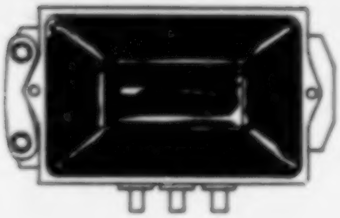
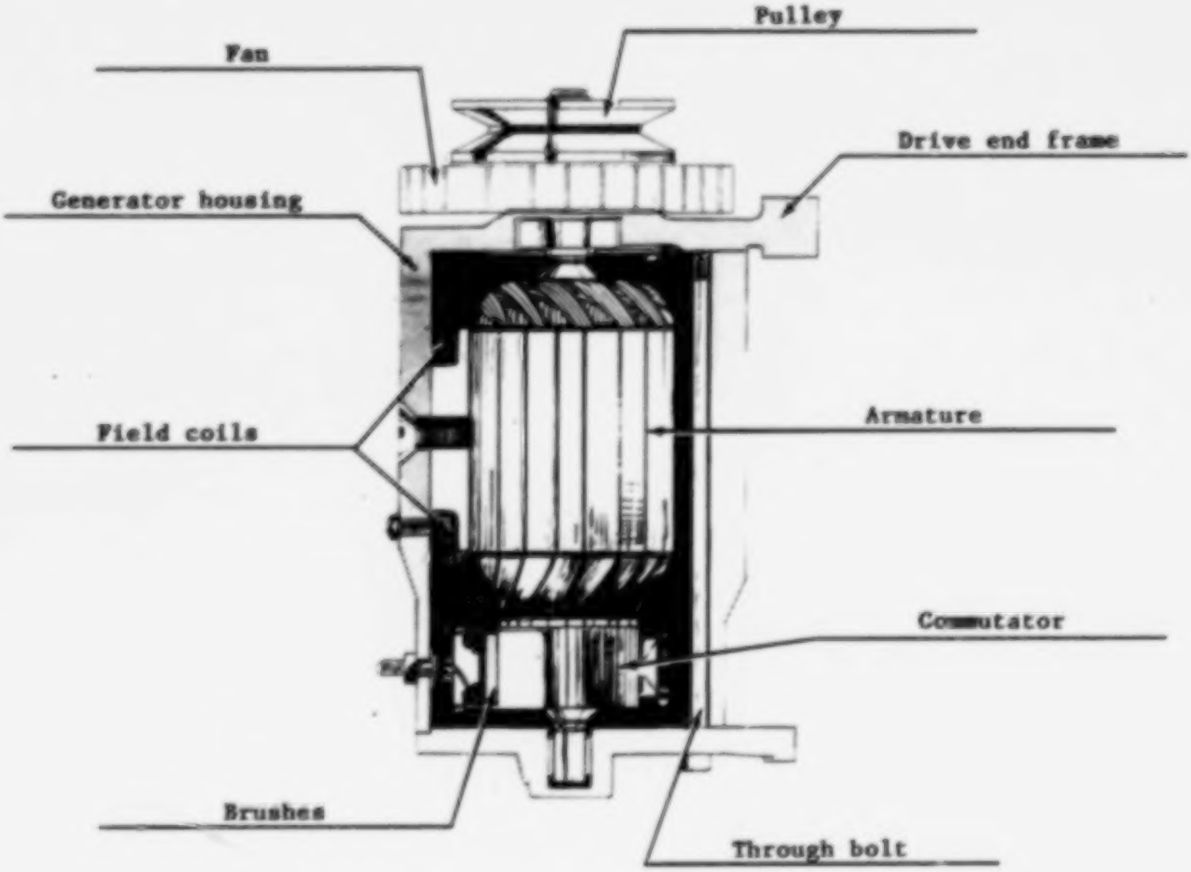


5. Identify the parts of the generator illustrated below. Write the correct names in the blanks.



LAP ASSIGNMENT SHEET #2

6. Match the lettered parts of the alternator shown below to their correct names. Write the letters in the blanks before the correct names of the parts.

a Brush assembly

g Diodes

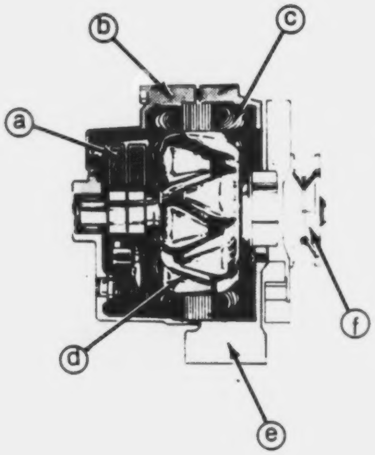
e Drive end frame

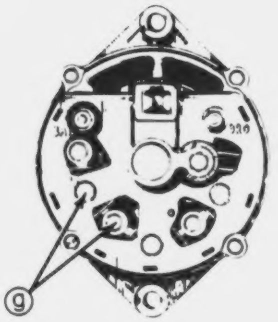
f Pulley

d Rotor assembly

b Slip ring end frame

c Stator assembly





LAP ASSIGNMENT SHEET #2

7. Fill in the missing words in the following sentences.

   a. Rotating armature windings inside a field and the use of a commutator to rectify output are two characteristics of a/an **generator**.

   b. Rotating field inside stationary windings and diodes used to rectify output are characteristics of a/an **alternator**.

   c. A/An **alternator** produces higher output at slower engine speeds.

   d. A/An **alternator** requires less maintenance.

   e. An alternator can produce more output at slower engine speeds because it has more **pole** **pieces** than a generator.

8. Describe the construction of a stator.

   Stator core is made of steel plates riveted together; three coil windings are attached to the core; stator is connected to rectifier assembly containing one positive and one negative diode rectifier per winding

9. Name the two types of alternator stator windings.

   a. **Wye - connected**

   b. **Delta - connected**

10. Read the following statements. Write a "T" in the blank if the statement is true or an "F" if the statement is false.

    F a. In an alternator, current capacity is regulated by the size of the wire used in each phase

    F b. Voltage in an alternator is regulated by current flow in the stator field

LAP ASSIGNMENT SHEET #2

11. Match the names and illustrations of the following voltage regulators. Write the correct letters in the blanks.

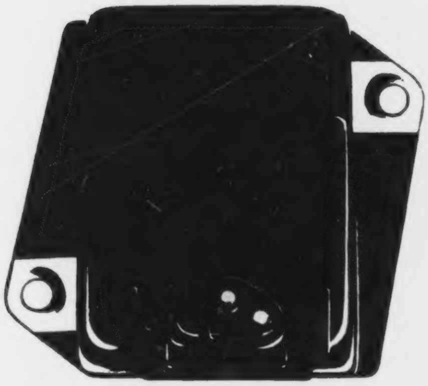
c Electromechanical

d Transistorized

a Electronic--external

b Electronic--internal

ⓐ



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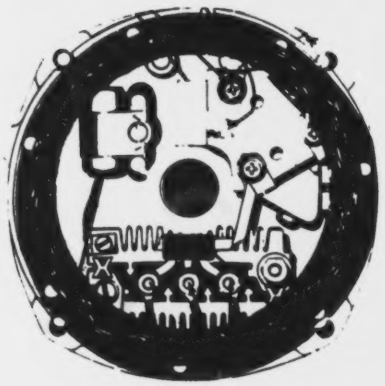

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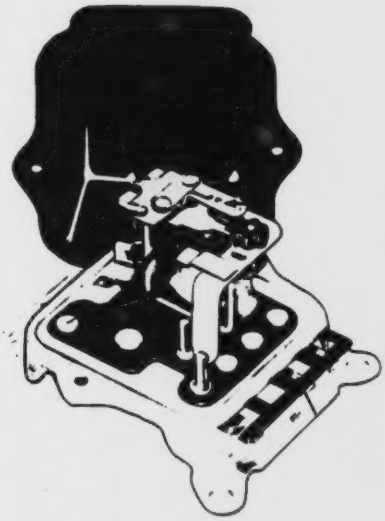

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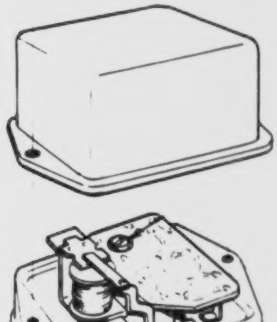


12. Stop. Have your instructor evaluate your assignment sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is requred, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction continue to Learning Step 7.

State Department
of
Vocational and Technical Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO.________ CODE:________

MAJOR INSTRUCTIONAL AREA SECTION B--ELECTRICAL SYSTEMS

INSTRUCTIONAL UNIT UNIT VI--CHASSIS WIRING

LEARNING ACTIVITY PACKET NO. 14

PREREQUISITE LAP(S) 9, 10

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Chassis Wiring." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to read a wiring diagram and test for short, open, and grounded circuits. The student should also be able to locate electrical problems, using a systematic approach, and make wiring repairs.

TASKS INCLUDED IN THIS LAP:

1. Install a soldered terminal.
2. Install a solderless terminal.
3. Splice a wire (solder method).
4. Splice a wire (solderless method).
5. Remove and replace a bulb.
6. Align headlights.
7. Remove and replace a sealed beam.
8. Remove and replace a headlight switch.
9. Remove and replace a power window motor.
10. Test circuit with voltmeter.
11. Test electrical motor current draw.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read Unit and Specific Objectives, pages AM II-315-B and 316-B.

_____ 2. Complete Chassis Wiring Pretest, LAP page 15.

_____ 3. Study The sections of the Information Sheet, pages AM II-319-B through 324-B indicated by your instructor on your pretest. Be sure to study the transparency masters when required.

_____ 4. Refer To Step 15 of the Pretest. If additional study is required, continue Learning to Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do LAP Assignment Sheet #1, LAP page 25.

_____ 6. Do LAP Assignment Sheet #2, LAP page 33.

_____ 7. Do Assignment Sheet #1--Read a Wiring Diagram, pages AM II-347-B and 348-B.

_____ 8. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Learning Step 10. Otherwise, continue to Learning Step 9.

_____ 9. Do LAP Assignment Sheet #3, LAP page 39.

LEARNING STEPS

_____10. Do — Assignment Sheet #2--Troubleshoot an Electrical Circuit, pages AM II-349-B and 350-B.

_____11. Stop. — Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Learning Step 13. Otherwise, continue to Learning Step 12.

_____12. Do — LAP Assignment Sheet #4, LAP page 41.

_____13. Check — The following tasks that you think you can perform without supervision.

		Instructor Initials/Date	
Student Check		Skilled	Moderately Skilled
_____a.	Install a soldered terminal (16)	_____	_____
_____b.	Install a solderless terminal (22)	_____	_____
_____c.	Splice a wire (solder method) (28)	_____	_____
_____d.	Splice a wire (solderless method) (34)	_____	_____
_____e.	Remove and replace a bulb (40)	_____	_____
_____f.	Align headlights (46)	_____	_____
_____g.	Remove and replace a sealed beam (52)	_____	_____
_____h.	Remove and replace a headlight switch (58)	_____	_____

LEARNING STEPS

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____i.	Remove and replace a power window motor (64)	__________	__________
_____j.	Test circuit with voltmeter (70)	__________	__________
_____k.	Test electrical motor current draw (76)	__________	__________

_____14. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed by your instructor, proceed to Learning Step 82. Otherwise, continue to Learning Step 15.

_____15. Refer — To Learning Step 13a. If this task has been initialed by your instructor, proceed to Learning Step 21. Otherwise, continue to Learning Step 16.

_____16. Study — Job Sheet #1--Install a Soldered Terminal, pages AM II-353-B and 354-B.

_____17. Watch — Slide/tape presentation, "Install a Terminal" (B-VI-1 & 2).

_____18. Do — Job Sheet #1--Install a Soldered Terminal.

_____19. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13a and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and then continue to Learning Step 20.

LEARNING STEPS

_____20. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13a and continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13a and continue to Learning Step 21.

_____21. Refer To Learning Step 13b. If this task has been initialed by your instructor, proceed to Learning Step 27. Otherwise, continue to Learning Step 22.

_____22. Study Job Sheet #2--Install a Solderless Terminal, pages AM II-355-B and 356-B.

_____23. Watch Slide/tape presentation, "Install a Terminal" (B-VI-1 & 2).

_____24. Do Job Sheet #2--Install a Solderless Terminal.

_____25. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13b and proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and then continue to Learning Step 26.

_____26. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13b and then continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13b and then continue to Learning Step 27.

LEARNING STEPS

_____27.	Refer	To Learning Step 13c. If this task has been initialed by your instructor, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.
_____28.	Study	Job Sheet #3--Splice a Wire (Solder Method), pages AM II-357-B and 358-B.
_____29.	Watch	Slide/tape presentation "Splice a Wire" (B-VI-3 & 4).
_____30.	Do	Job Sheet #3--Splice a Wire (Solder Method).
_____31.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13c and proceed to Learning Step 33. Otherwise, repeat Learning Steps 28 through 30 and then continue to Learning Step 32.
_____32.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13c and continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13c and continue to Learning Step 33.
_____33.	Refer	To Learning Step 13d. If this task has been initialed by your instructor, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.
_____34.	Study	Job Sheet #4--Splice a Wire (Solderless Method), pages AM II-359-B and 360-B.

LEARNING STEPS

_____35. Watch Slide/tape presentation, "Splice a Wire" (B-VI-3 & 4).

_____36. Do Job Sheet #4--Splice a Wire (Solderless Method).

_____37. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13d and proceed to Learning Step 39. Otherwise, repeat Learning Steps 34 through 36 and then continue to Learning Step 38.

_____38. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13d and continue to Learning Step 39. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13d and then continue to Learning Step 39.

_____39. Refer To Learning Step 13e. If this task has been initialed by your instructor, proceed to Learning Step 45. Otherwise, continue to Learning Step 40.

_____40. Study Job Sheet #5--Remove and Replace a Bulb, pages AM II-361-B and 362-B.

_____41. Watch Slide/tape presentation, "Remove and Replace a Bulb" (B-VI-5).

_____42. Do Job Sheet #5--Remove and Replace a Bulb.

_____43. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13e and proceed to Learning Step 45. Otherwise, repeat Learning Steps 40 through 42 and then continue to Learning Step 44.

_____44. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13e and then continue to Learning Step 45. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13e and then continue to Learning Step 45.

_____45. Refer To Learning Step 13f. If this task has been initialed by your instructor, proceed to Learning Step 51. Otherwise, continue to Learning Step 46.

_____46. Study Job Sheet #6--Align Headlights, page AM II-363-B.

_____47. Watch Slide/tape presentation, "Remove, Replace, and Align Sealed-Beam Headlights" (B-VI-6 & 7).

_____48. Do Job Sheet #6--Align Headlights.

_____49. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13f and proceed to Learning Step 51. Otherwise, repeat Learning Steps 46 through 48 and then continue to Learning Step 50.

LEARNING STEPS

_____50.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13f and continue to Learning Step 51. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13f and continue to Learning Step 51.
_____51.	Refer	To Learning Step 13g. If this task has been initialed by your instructor, proceed to Learning Step 57. Otherwise, continue to Learning Step 52.
_____52.	Study	Job Sheet #7--Remove and Replace a Sealed Beam, page AM II-365-B.
_____53.	Watch	Slide/tape presentation, "Remove, Replace, and Align Sealed-Beam Headlights" (B-VI-6 & 7).
_____54.	Do	Job Sheet #7--Remove and Replace a Sealed Beam.
_____55.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13g and proceed to Learning Step 57. Otherwise, repeat Learning Steps 52 through 54 and then continue to Learning Step 56.
_____56.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13g and continue to Learning Step 57. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13g and then continue to Learning Step 57.

LEARNING STEPS

_____57. Refer — To Learning Step 13h. If this task has been initialed by your instructor, proceed to Learning Step 63. Otherwise, continue to Learning Step 58.

_____58. Study — Job Sheet #8--Remove and Replace a Headlight Switch, pages AM II-367-B through AM II-369-B.

_____59. Watch — Slide/tape presentation, "Remove and Replace a Headlight Switch" (B-VI-8).

_____60. Do — Job Sheet #8--Remove and Replace a Headlight Switch.

_____61. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13h and then proceed to Learning Step 63. Otherwise, repeat Learning Steps 58 through 60 and then continue to Learning Step 62.

_____62. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13h and continue to Learning Step 63. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13h and then continue to Learning Step 63.

_____63. Refer — To Learning Step 13i. If this task has been initialed by your instructor, proceed to Learning Step 69. Otherwise, continue to Learning Step 64.

_____64. Study — Job Sheet #9--Remove and Replace a Power Window Motor, pages AM II-371-B through 374-B.

LEARNING STEPS

____65.	Watch	Slide/tape presentation, "Remove and Replace a Power Window Motor" (B-VI-9).
____66.	Do	Job Sheet #9--Remove and Replace a Power Window Motor.
____67.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13i and proceed to Learning Step 69. Otherwise, repeat Learning Steps 64 through 66 and then continue to Learning Step 68.
____68.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13i and continue to Learning Step 69. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13i and continue to Learning Step 69.
____69.	Refer	To Learning Step 13j. If this task has been initialed by your instructor, proceed to Learning Step 75. Otherwise, continue to Learning Step 70.
____70.	Study	Job Sheet #10--Test Circuit with Voltmeter, pages AM II-375-B through 378-B.
____71.	Watch	Slide/tape presentation, "Test Circuits with Voltmeter" (B-VI-10).
____72.	Do	Job Sheet #10--Test Circuit with Voltmeter.

LEARNING STEPS

_____73. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13j and proceed to Learning Step 75. Otherwise, repeat Learning Steps 70 through 72 and then continue to Learning Step 74.

_____74. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13j and then continue to Learning Step 75. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13j and then continue to Learning Step 75.

_____75. Refer To Learning Step 13k. If this task has been initialed by your instructor, proceed to Learning Step 81. Otherwise, continue to Learning Step 76.

_____76. Study Job Sheet #11--Test Electrical Motor Current Draw, pages AM II-379-B through AM II-383-B.

_____77. Watch Slide/tape presentation, "Test Electrical Motor Current Draw" (B-VI-11).

_____78. Do Job Sheet #11--Test Electrical Motor Current Draw.

_____79. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13k and proceed to Learning Step 81. Otherwise, repeat Learning Steps 76 through 78 and then continue to Learning Step 80.

LEARNING STEPS

_____80. Stop. Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 13k and continue to Learning Step 81. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 13k and continue to Learning Step 81.

_____81. Refer To Learning Step 13. If all tasks have been initialed by your instructor, continue to Learning Step 82. Otherwise, refer to the Learning Step indicated in parentheses after the unsigned task.

_____82. Review Information Sheet, pages AM II-319-B through 324-B, Assignment Sheets, and LAP Assignment Sheets.

_____83. Take Chassis Wiring Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

PRETEST

NAME ______________________ SCORE ______________

DIRECTIONS: The purpose of this pretest is to determine how much you already know about chassis wiring. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may keep you from receiving needed instruction.

1. Define the following terms.

   a. Ground--**Negative or uninsulated side of a circuit**

   b. Circuit--**Continuous conductor path through which current flows from an electrical source, through a load, and back to the source**

   c. Polarity--**Term applied to the ends of a magnet; direction of current flow in a circuit**

   d. Short circuit--**Defect that allows electrical current to take a shorter path**

   e. Bulb--**Electrical light-producing device**

   f. Double filament--**Bulb with two filaments**

   g. Wiring harness--**System of wires usually taped together that distributes electricity throughout a vehicle**

   h. Single filament--**Bulb with one filament**

   i. Filament--**Finely coiled tungsten wire that is sealed in a glass chamber**

j. Amperage--**Unit of measure for current flow**

k. Insulator--**Material that prevents electrical current from passing between two conductors**

l. Conductor--**Material that carries electrical current from a source to a load and back to the source**

m. Voltage--**Unit of measure for electrical pressure**

n. Resistance--**Opposition to electrical flow**

o. Series circuit--**Circuit that has only one path of current flow**

p. Open circuit--**Circuit with a broken conductor or a bad connection**

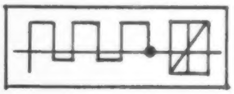
q. Series-parallel circuit--**Combination of series and parallel circuits**

r. Parallel circuit--**Circuit with two or more paths of current flow**

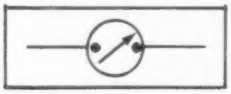
s. Terminal--**Screw, post, pin, or socket at the end of a wire or cable**

t. Switch--**Mechanical device used to open and close a circuit**

2. Identify the following electrical symbols. Write the meanings of the symbols in the blanks below the drawings.

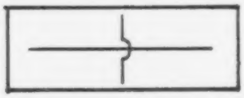


a. **Voltage limiter**

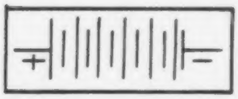


b. **Gauge**

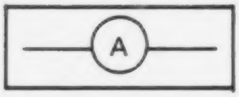
PRETEST



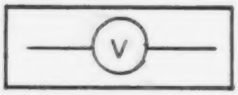
c. **Crossover conductor**



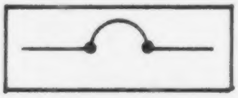
d. **12-volt battery**



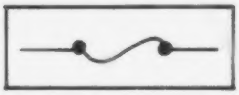
e. **Ammeter**



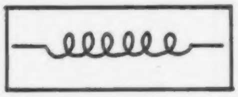
f. **Voltmeter**



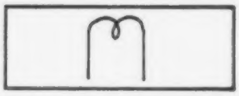
g. **Circuit breaker**



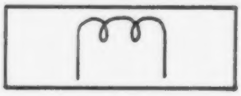
h. **Fuse**



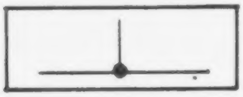
i. **Coil**



j. **Single-filament lamp**

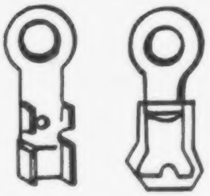


k. **Double-filament lamp**

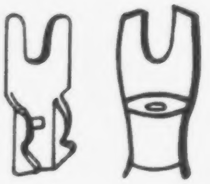


l. **Connected conductor**

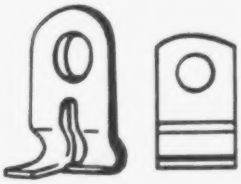
3. Identify the following electrical terminals and connectors. Write the correct names in the blanks below the drawings.



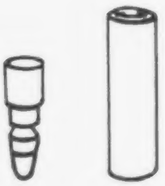
a. **Ring**



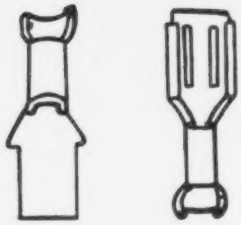
b. **Spade**



c. **Roll**

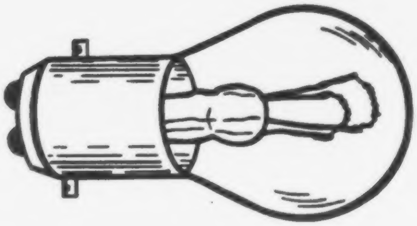


d. **Bullet**

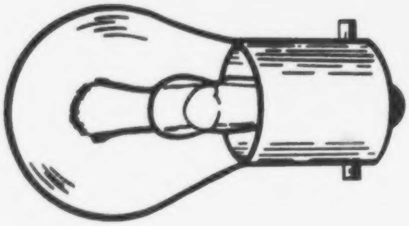


e. **Blade**

4. Identify the two bulbs shown. Write their correct names in the blanks.



a. **Double filament**



b. **Single filament**

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PRETEST

5. Identify the parts of the sealed-beam headlight. Write the correct names in the blanks.

a. **Locating lug**

b. **Indicates single or double filament**

c. **Aiming lug**

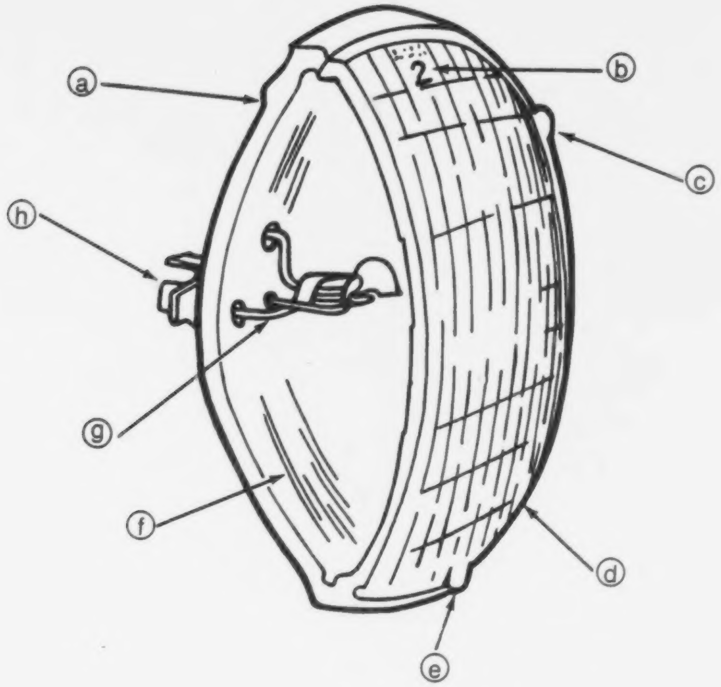
d. **Lens**

e. **Aiming lug**

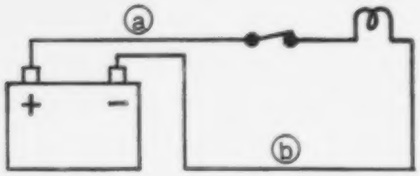
f. **Reflector**

g. **Filaments**

h. **Electrical terminals**



6. Identify the hot and ground parts of a circuit. Write the correct letters in the blanks.



a Hot

b Ground

7. Explain voltage drop and current draw by completing the following sentences.

   a. Voltage drop occurs when **electricity flows through a resistance**

   b. Voltage drop can be measured directly by **connecting the voltmeter across the component with the circuit operating**

   c. Voltage drop adds up when **connected in series with the load**

   d. Current draw cannot be read in an open circuit because **there is no current flow**

   e. Current draw is highest with **no resistance**

   f. Current draw reduces when **resistance is added in series**

   g. Current draw increases when **loads are added in parallel**

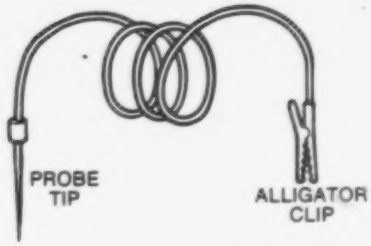
   h. Current draw test is useful for determining if **a motor is operating against a mechanical load**

8. Fill in the missing words in the following statements about single-wire and two-wire circuits.

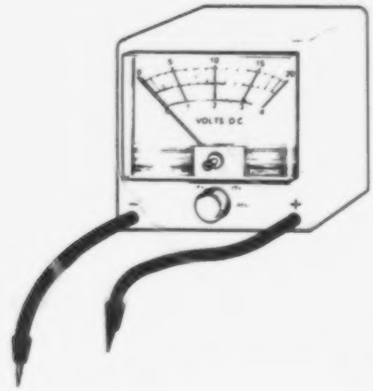
   A two-wire circuit uses a wire for the **hot** side of a circuit and a wire for the **ground** side of the circuit. A single-wire circuit uses the **vehicle chassis** for the ground side of the circuit.

PRETEST

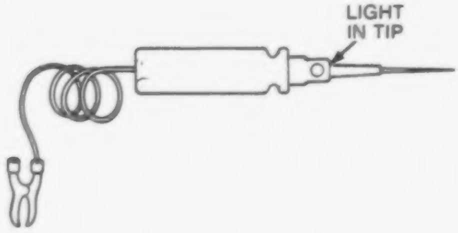
9. Identify the following test instruments. Write the correct names in the blank.



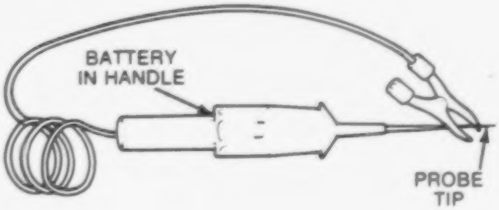
a. **Jumper wire**



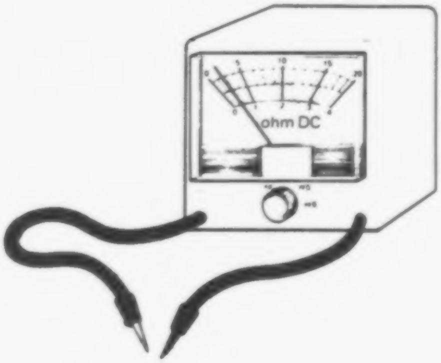
b. **Voltmeter**



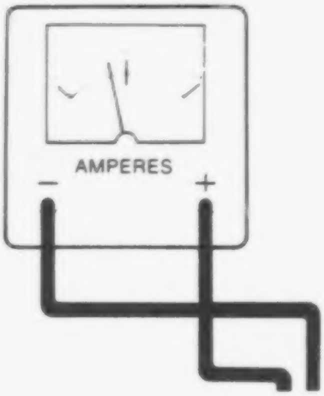
c. **Continuity test light**



d. **Continuity test light (self-powered)**



e. **Ohmmeter**



f. **Ammeter**

10. List the steps to follow when diagnosing electrical problems.

    a. **Determine the problem**

    b. **Trace the circuit**

    c. **Isolate the problem**

    d. **Test systematically**

    e. **Verify the problem**

    f. **Repair**

    g. **Test the repair**

11. Fill in the missing words to complete the following statements about characteristics of a wiring diagram.

    a. Lines represent **wires**.

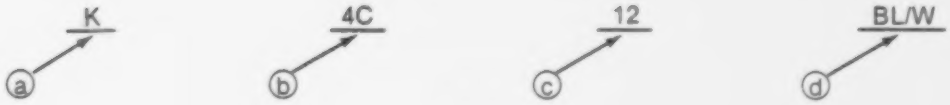
    b. **Wires** have identification numbers.

    c. **Wires** are color coded.

    d. **Components** are represented by symbols.

    e. Symbols indicate locations of **circuits** or **components** in the vehicle.

12. Identify the parts of the circuit identification code shown below. Write the correct names in the blanks.



    a. **Main circuit identification**

    b. **Sub group of main circuit**

    c. **Gauge of wire**

    d. **Color code**

13. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I

_____II

_____III

_____IV

_____V

_____VI

_____VII

_____VIII

_____IX

_____X

_____XI

_____XII

_____XIII

You came here from Learning Step 2. If none of the above sections ar checked, proceed to Learning Step 13. Otherwise, continue to Learning Step 3.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

LAP ASSIGNMENT SHEET #1

NAME ____________________ SCORE ____________________

1. Match the following terms and definitions. Write the correct numbers in the blanks.

19 a. Measure of electrical pressure

1 b. Measure of electrical current

12 c. Opposition to electrical flow

4 d. Material that carries current from the source to the load and back to the source

8 e. Material that prevents current flow from transferring from one conductor to another

3 f. Continuous conductor path

13 g. Circuit with only one current path

11 h. Circuit with two or more current paths

14 i. Combination of parallel and series circuits

9 j. Circuit with poor connection or broken conductor

18 k. Screw, post, pin, or socket at the end of a wire or cable

15 l. Mechanical device used to open and close a circuit

10 m. Direction of current flow in a circuit

2 n. Electrical device that produces light

6 o. Finely coiled tungsten wires that are sealed in a glass chamber

1. Amperage.
2. Bulb
3. Circuit
4. Conductor
5. Double filament
6. Filament
7. Ground
8. Insulator
9. Open circuit
10. Polarity
11. Parallel circuit
12. Resistance
13. Series circuit
14. Series-parallel circuit
15. Switch
16. Single filament
17. Short circuit
18. Terminal
19. Voltage
20. Wiring harness

LAP ASSIGNMENT SHEET #1

16 p. Bulb with only one filament

5 q. Bulb with two filaments

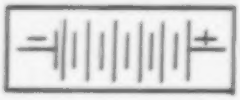
20 r. System of wires that distributes electricity

17 s. Wiring defect that permits current to take a shorter path

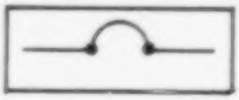
7 t. Negative or uninsulated side of a circuit

2. Identify the electrical symbols shown below. Write the correct names in the blanks.

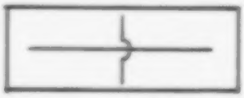
a. **Battery**



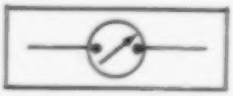
b. **Circuit breaker**



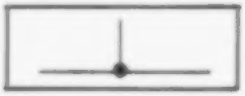
c. **Crossover conductor**



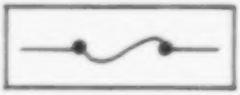
d. **Gauge**



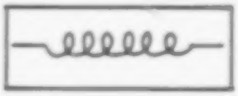
e. **Connected conductor**



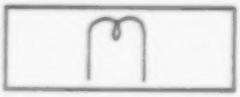
f. **Fuse**



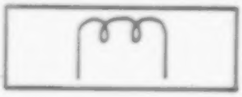
g. **Coil**



h. **Single filament lamp**

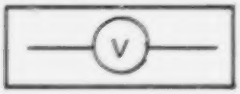


i. **Double filament lamp**

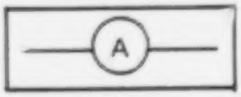


LAP ASSIGNMENT SHEET #1

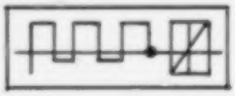
j. **Voltmeter**



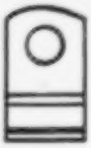
k. **Ammeter**



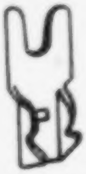
l. **Voltage limiter**



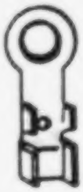
3. Identify the terminals and connectors shown below. Write the correct names in the blanks.



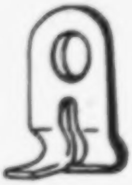
a. **Roll**



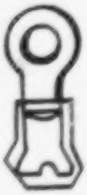
b. **Spade**



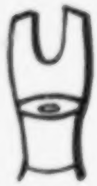
c. **Ring**



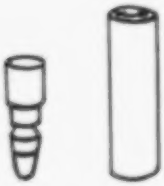
d. **Roll**



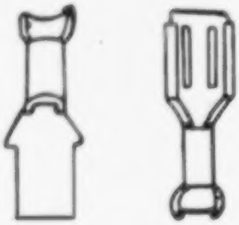
e. **Ring**



f. **Spade**

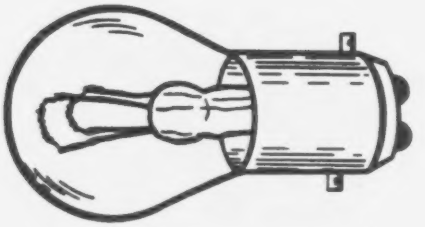


g. **Bullet**

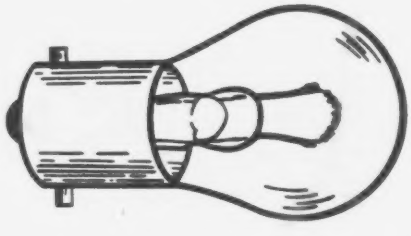


h. **Blade**

4. Identify the two types of bulbs shown. Write their correct names in the blanks.



a. **Double filament**

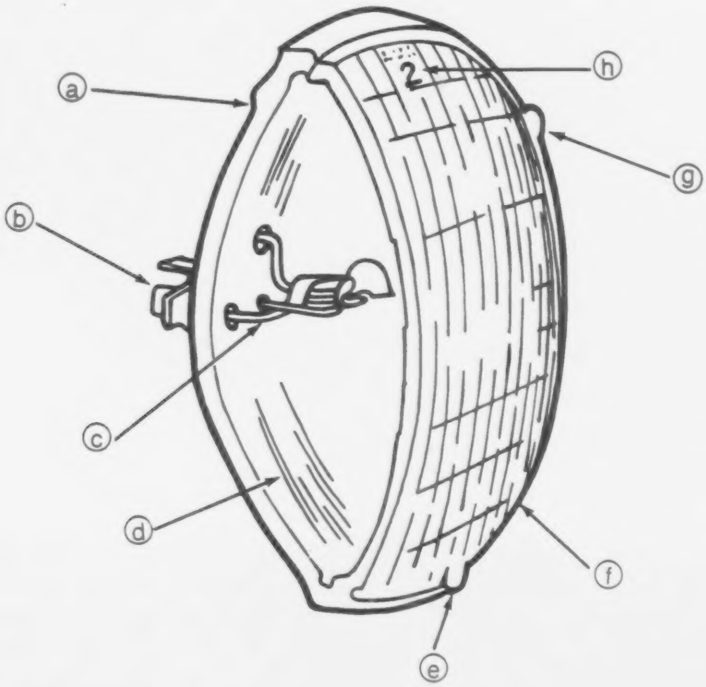


b. **Single filament**

5. Match the names of parts of the sealed beam and their locations on the illustration below. Write the correct letters in the blanks. (A blank may have more than one correct answer.)

c Filaments
f Lens
a Locating lug
e,g Aiming lug

d Reflector
b Terminals
h Number of filaments



LAP ASSIGNMENT SHEET #1

6. Explain the difference between hot and ground circuits.

A hot circuit runs from the positive battery terminal to the load. A ground circuit returns from the load to the negative battery cable.

7. List four facts about voltage drop.

a. **Occurs when electricity flows through resistance**

b. **Resistance can be a load such as an electrical motor or a lamp, or a poor connection**

c. **Voltage drop can be measured by connecting a voltmeter across the component with the circuit operating**

d. **Voltage drop adds up when components are connected in series**

8. List five facts about current draw.

a. **Current draw cannot be read in an open circuit**

b. **Current draw is highest with no resistance**

c. **Current draw reduces as resistance is added in series**

d. **Current draw increases as loads are added in parallel**

e. **Current draw test determines if an electric motor is operating against a mechanical bind**

LAP ASSIGNMENT SHEET #1

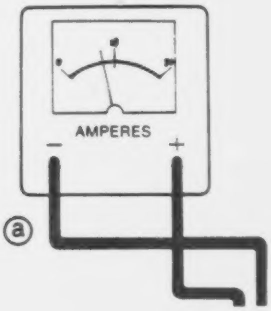
9. Explain the difference between single-wire and two-wire circuits.

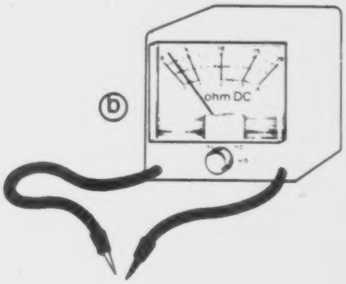
Single-wire circuits are common in a vehicle where a wire is run as the hot side of the circuit and the vehicle chassis serves as the ground side of the circuit. In a two-wire circuit, a wire is used to carry the ground.

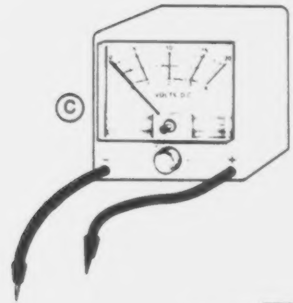
10. Match the names and illustrations of the following test instruments. Write the correct letters in the blanks.

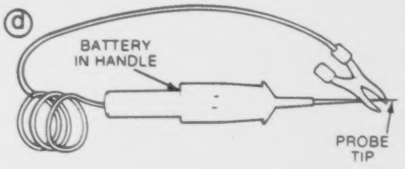
b Ohmmeter
c Voltmeter
a Ammeter

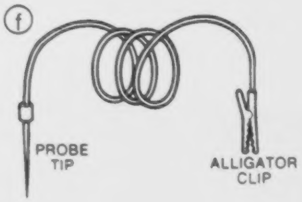
f Jumper wire
d Continuity testlight (self-powered)
e Continuity testlight

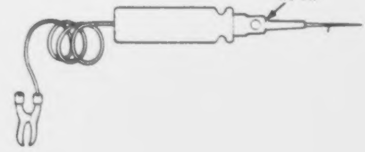












LAP ASSIGNMENT SHEET #1

11. Arrange in order the steps to follow when diagnosing an electrical problem. Write a "1" before the first step, a "2" before the second step, and so on.

2 a. Trace the circuit

3 b. Isolate the problem

1 c. Determine the problem

6 d. Repair

7 e. Test the repair

5 f. Verify the problem

4 g. Test systematically

12. List five characteristics of a wiring diagram.

a. **Lines represent wires**

b. **Wires have identification numbers**

c. **Wires are color-coded**

d. **Symbols represent components**

e. **Symbols also indicate location of components or circuits**

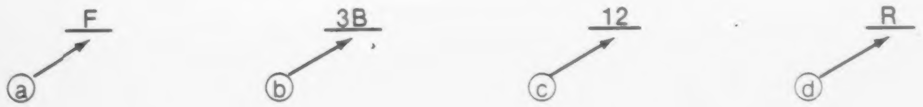
13. Identify the parts of the wiring code shown. Write the correct names in the blanks.

a. **Main circuit identification**

b. **Part of main circuit**

c. **Size or gauge of wire**

d. **Color code of wire**



LAP ASSIGNMENT SHEET #1

14. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I
_____II
_____III
_____IV
_____V
_____VI
_____VII
_____VIII
_____IX
_____X
_____XI
_____XII
_____XIII

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

LAP ASSIGNMENT SHEET #2

NAME ______________________________ SCORE ____________________

1. Identify the terms defined below. Write the correct terms in the blanks.

a. **Ground**--Negative or uninsulated side of a circuit.

b. **Voltage**--Measurement of electrical pressure.

c. **Short circuit**--Defect that permits current flow around a load.

d. **Amperage**--Measurement of electrical current.

e. **Wiring hardness**--System of wires, usually taped together.

f. **Resistance**--Opposition to electrical flow.

g. **Double-filament bulb**--Bulb with two filaments.

h. **Conductor**--Material that transmits electricity from the source to the load and back to the source.

i. **Insulator**--Material that prevents current from transferring from one conductor to another.

j. **Single-filament bulb**--Bulb with only one filament.

k. **Circuit**--Continuous conductor path.

l. **Filament**--Coiled tungsten wires that are sealed in a glass chamber.

m. **Series circuit**--Circuit with a single current path.

n. **Bulb**--Light-producing electrical device.

o. **Parallel circuit**--Circuit with two current paths.

p. **Polarity**--Direction of current flow in a circuit.

q. **Series-parallel circuit**--Combination of series and parallel circuits.

r. **Switch**--Device used to open and close a circuit.

s. **Open circuit**--Circuit with a broken conductor or poor connection.

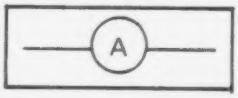
t. **Terminal**--Screw, post, pin, or socket at the end of a wire or cable.

LAP ASSIGNMENT SHEET #2

2. Match components and their common electrical symbols. Write the correct letters in the blanks.

e Gauge
f Battery
a Ammeter
d Circuit breaker
b Voltmeter
i Crossover conductor

g Coil
k Single-filament lamp
l Double-filament lamp
j Voltage limiter
c Fuse
h Connected conductor

ⓐ


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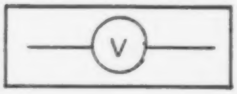

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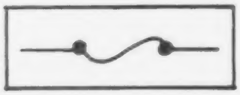

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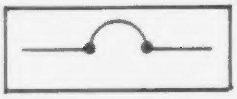

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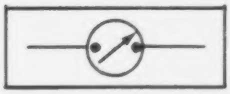

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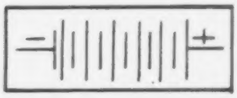

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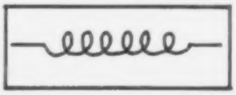

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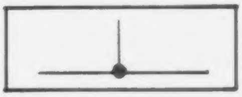

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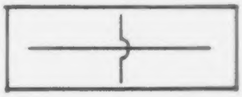

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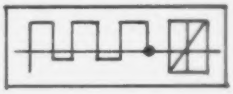

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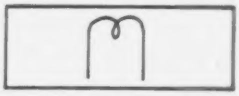

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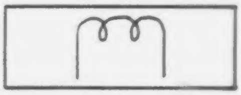


3. Name types of electrical terminals and connectors.

SOLDER TYPE TERMINALS

a. **Ring**

b. **Spade**

c. **Roll**

SOLDERLESS TYPE TERMINALS

a. **Ring**

b. **Spade**

c. **Roll**

CONNECTORS

a. **Bullet**

b. **Blade**

LAP ASSIGNMENT SHEET #2

4. Name the two types of bulbs used in automobiles.

   a. **Single filament**

   b. **Double filament**

5. Identify the parts of the sealed-beam lamp. Write the correct names in the blanks.

   a. **Lens**

   b. **Aiming lug**

   c. **Reflector**

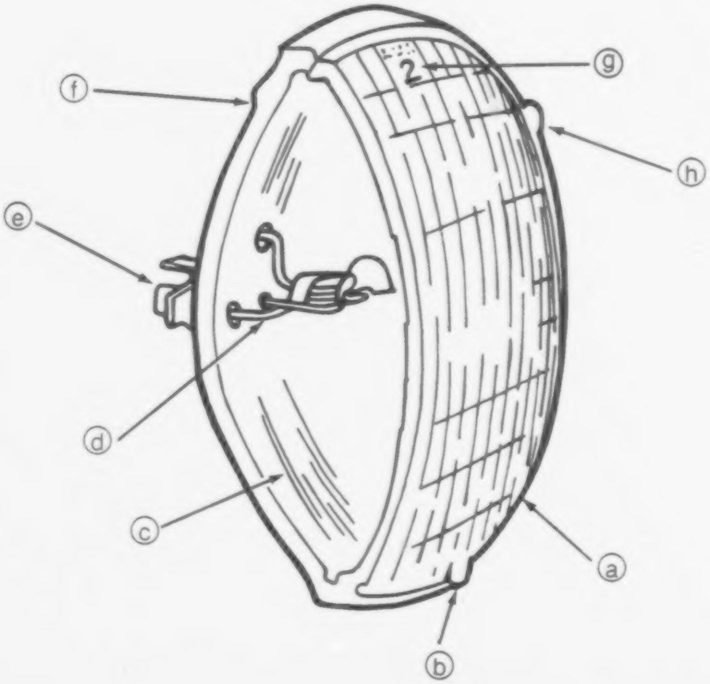
   d. **Filaments**

   e. **Electrical terminals**

   f. **Locating lug**

   g. **Number of filaments**

   h. **Aiming lug**



LAP ASSIGNMENT SHEET #2

6. Fill in the missing words in the statement below.

   Generally, the hot side of a circuit is attached to the **positive** battery post, and the ground side runs to the **negative** battery post.

7. Distinguish between facts about voltage drop and current draw. Write a "V" in the blanks before facts about voltage drop and a "C" in the blanks before facts about current draw.

   C a. Cannot be read in an open circuit

   C b. Is highest with no resistance in the circuit

   V c. Adds up when loads are connected in series

   C d. Increases when loads are connected in parallel

   V e. Can be measured with a voltmeter

   C f. Reduces as loads are added in series

   V g. Occurs when electricity flows through a resistance

   C h. Can be used to check operation of an electrical motor

8. Which kind of circuits, single-wire or two-wire, are most commonly used in automobiles?

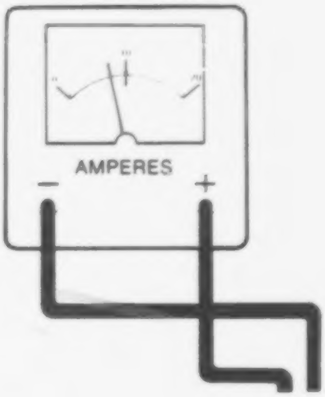
   Single-wire circuits

9. Explain the difference between single-wire and two-wire circuits.

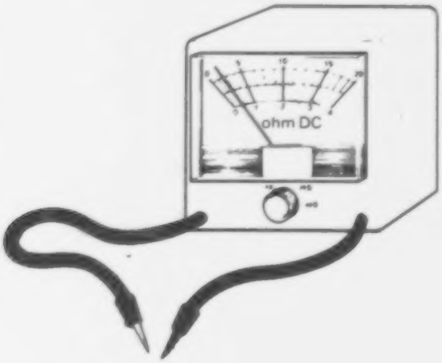
   A two-wire circuit uses wire on both the hot and ground sides of a circuit. A single-wire circuit uses a hot wire on the positive side of the circuit and uses the vehicle chassis as the ground side of the circuit.

LAP ASSIGNMENT SHEET #2

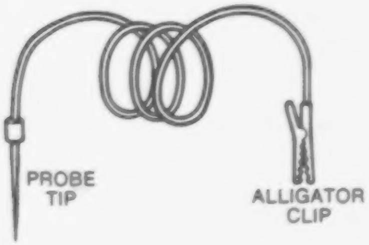
10. Identify the following test instruments. Write the correct names in the blanks.



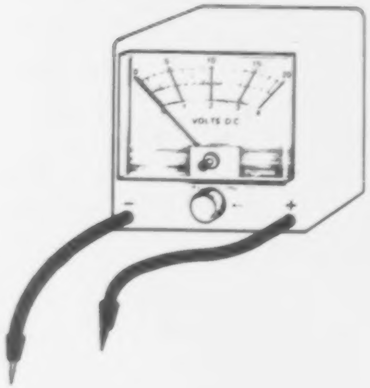
a. **Ammeter**



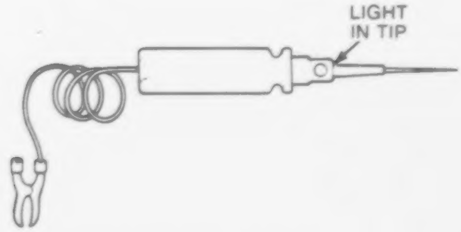
b. **Voltmeter**



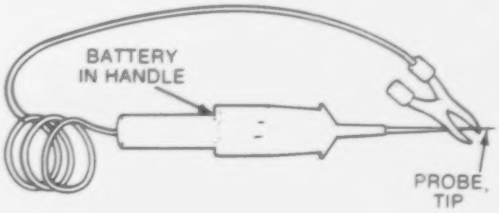
c. **Jumper Wire**



d. **Ohmmeter**



e. **Continuity test light**



f. **Continuity test light (self-powered)**

LAP ASSIGNMENT SHEET #2

11. List in order the steps to follow when diagnosing an electrical problem.

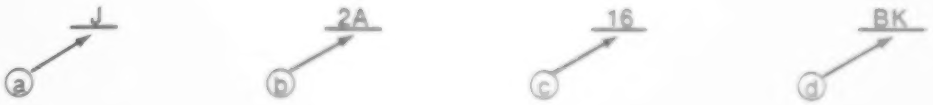
    a. **Determine the problem**
    b. **Trace the circuit**
    c. **Isolate the problem**
    d. **Test systematically**
    e. **Verify the problem**
    f. **Repair**
    g. **Test the repair**

12. List five characteristics of a wiring diagram.

    a. **Lines represent wires**
    b. **Wires have identification numbers**
    c. **Wires are color coded**
    d. **Symbols represent components**
    e. **Symbols indicate locations of circuits or components**

13. Identify the parts of the following typical circuit identification code. Write the correct names in the blanks.

    a. **Main circuit identification**
    b. **Part of main circuit**
    c. **Gauge of wire (size)**
    d. **Color code of wire**

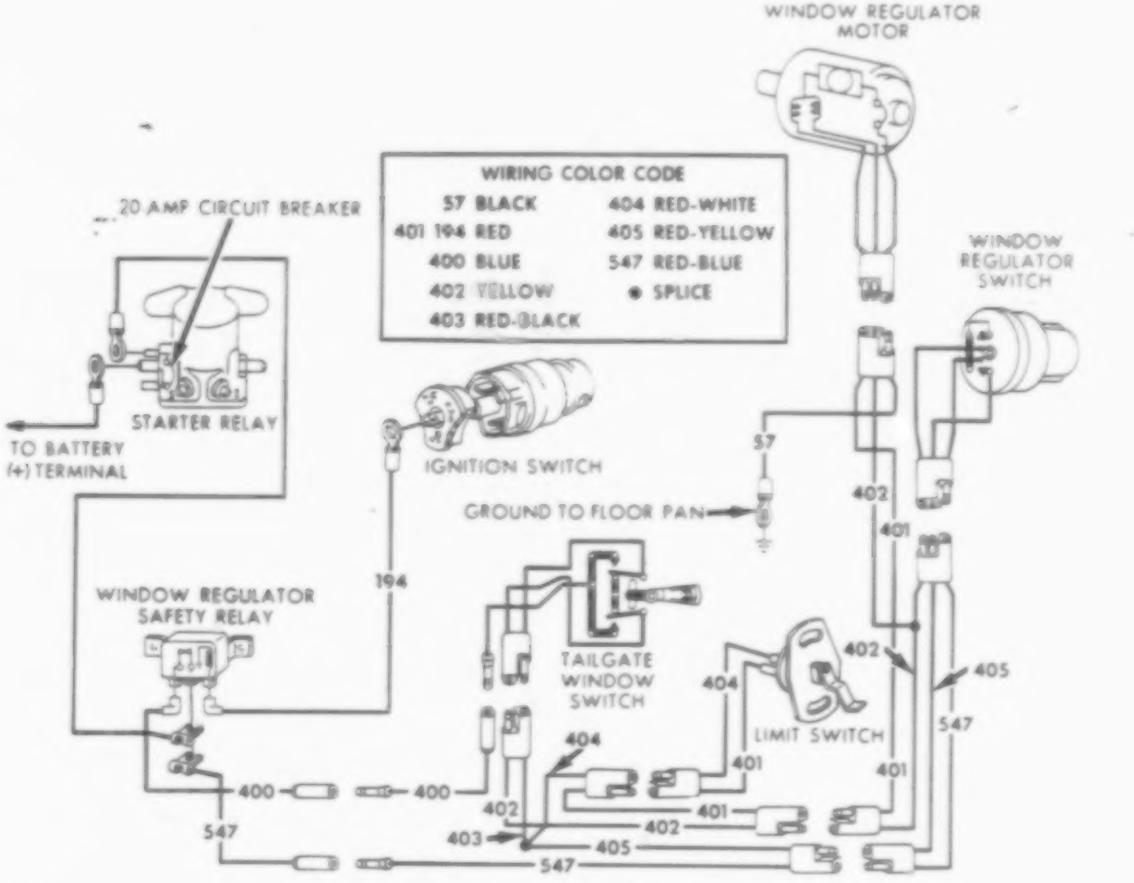


14. Stop. Have your instructor evaluate your LAP Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

LAP ASSIGNMENT SHEET #3

NAME ______________________________ SCORE ____________________



Use the wiring diagram to answer the following questions.

1. List the wire color for the following components.

   a. Ignition switch to safety relay **Red**

   b. Regulator motor to ground **Black**

   c. Regulator switch to motor **Yellow**

   d. Safety relay to tailgate switch **Blue**

   e. Limit switch to regulator motor **Red**

LAP ASSIGNMENT SHEET #3

2. What are the three wire colors connected to the window regulator motor?

   Black, red, yellow

3. What two components are connected to the starter relay in this wiring diagram?

   Positive battery terminal and safety relay

4. What does the (•) indicate on this wiring diagram?

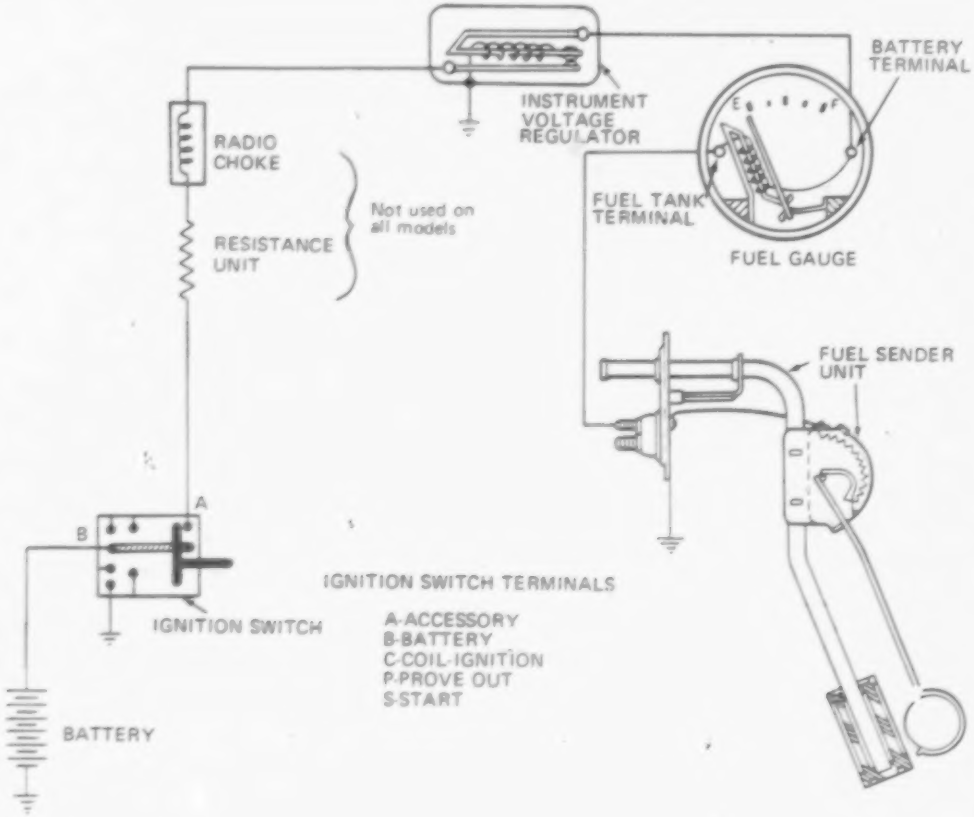
   Splice

5. Stop. Have your instructor evaluate your LAP Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 10. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 10.

SECTION B--ELECTRICAL SYSTEMS
UNIT VI--CHASSIS WIRING

LAP ASSIGNMENT SHEET #4

NAME ______________________________ SCORE ____________________



Use the wiring diagram to answer the following questions.

1. How many grounds are shown in this diagram? **Four**

2. If the fuel gauge shows empty regardless of the fuel level, what are the possible causes of the problem?

Defective load to gauge from battery, defective instrument, defective voltage regulator, defective sender unit, defective ground, defective resistance unit or radio choke

LAP ASSIGNMENT SHEET #4

3. Describe how to test for each possible defect you listed in your answer to the previous question.

Defective battery load or radio choke resistance--Use a continuity tester

to locate defective component or conductor

Defective instrument--Check for voltage across gauge terminals

Defective sending unit--Use ohmmeter across unit terminals

Defective ground--Use jumper wire from sender ground terminal to ground

4. Stop. Have your instructor evaluate your LAP Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 13. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 13.